APPLETONS'
POPULAR SCIENCE
MONTHLY.

FEBRUARY, 1897.

HERBERT SPENCER: THE MAN AND HIS WORK.

By WILLIAM HENRY HUDSON,
PROFESSOR OF ENGLISH LITERATURE IN THE LELAND STANFORD JUNIOR UNIVERSITY.

IN a famous passage in his autobiography, Edward Gibbon has told us of the mingled emotions with which, on a memorable night in June, 1787, he penned the last lines of the last page of his History, and thus closed the undertaking of many laborious years. In a somewhat similar, though at once more dignified and more touching strain, Mr. Spencer, in the preface to his recently published third volume of the Principles of Sociology, has set on record his feelings on reviewing his finished life-work —a work beside which even the vast enterprise of Gibbon sinks into insignficance: "Doubtless in earlier years some exultation would have resulted; but as age creeps on feelings weaken, and now my chief pleasure is in my emancipation. Still, there is satisfaction in the consciousness that losses, discouragements, and shattered health have not prevented me from fulfilling the purpose of my life."

The Synthetic Philosophy, then, is to-day an accomplished fact. When Mr. Spencer first entered upon his work, he estimated that it would commit him to at least twenty years of regular and persistent toil, allowing two years to each of the ten stout volumes called for by his plan. Reckoning from the publication of the initial installment of First Principles in October, 1860, it has actually occupied just thirty-six years. Commenced with little encouragement from the cultured world, and even against the more cautious judgment of immediate advisers, at a time when its author was already broken down in health, with uncertain financial outlook and narrowly limited working powers,

it has been pushed slowly and painfully toward completion in the face of difficulties that might well have seemed not merely stupendous but insuperable. Only those who have closely watched the progress of the undertaking—perhaps even only those who have been privileged to step behind the curtain and learn at first hand the conditions under which the work has been done—can really be in a position to appreciate the man's high courage, steady perseverance, and single-hearted devotion to a cherished ideal. Obstacles of many kinds he had foreseen from the outset, but these were as little in comparison with the unlooked-for impediments which he was presumably to find blocking his way. For a time the practical support yielded him by the reading public was so slight that he seriously contemplated the abandonment of his labors altogether. After this interruptions occurred with increasing frequency in various unexpected ways. He was forced to pause in the methodical unfolding of his plan, to explain, restate, clear up misconceptions, and reply to criticisms. His energies were on several occasions drawn off into other, though in most cases directly subsidiary, lines of work. The supervision of the compilation of the Descriptive Sociology, itself an enormous task; the writing for the International Scientific Series of his Study of Sociology; the publication of a number of timely essays (such as those making up The Man *versus* the State), rendered necessary, as Mr. Spencer felt, by the conditions and tendencies of public affairs—all these things, valuable as we know them to be, none the less delayed the prosecution of the larger design. And, worse than all, his physical powers, as the years went on, in spite of temporary fluctuations and improvements, continued, upon the whole, steadily to decline. He had reckoned, in starting, on a regular working day of three hours. The calculation, moderate as it appeared to be, was presently proved altogether extravagant. Only by the most careful husbanding of his energies has sustained labor been possible to him at all. Absolute inaction has often been forced upon him as the sole means of recuperating his overtaxed strength, while through many a lengthy period of sleeplessness and prostration the dictation of a paragraph or two each morning has represented the extreme reach of his productive capacity. That under such circumstances as these the majestic edifice which he had designed should have continued to rise, stone by stone, is itself a fact not easily paralleled in the history of philosophy or letters; nor is it wonderful that, till within a short time since, most of us should have regarded the ultimate crowning of the structure as almost, if not quite, an impossibility. Two years ago, in a biographical sketch of Mr. Spencer, I wrote skeptically of such a consummation, adding, however, as a word of encouragement, that from a man of his extraordinary reso-

lution and perseverance much might still be looked for. And now the event has justified my half-doubtful prediction, and the Synthetic Philosophy has been rounded off to a completed whole.

Of the importance of this finished work as a fact in the intellectual annals of the nineteenth century much might, of course, be said. That it is in itself the largest, most comprehensive, and most ambitious plan conceived and wrought out by any single thinker of our time is obvious to all; nor will it be less obvious to those who concern themselves in any way with the progress of thought that, measured alike by the constructive genius manifested in, and the far-reaching influence exerted by it, the Synthetic Philosophy towers superbly above all other philosophic achievements of the age. There is no field of mental activity that Mr. Spencer has not to some extent made his own; no line of inquiry in which his power has not been felt. Even those who differ the most radically from him are at the same time compelled to define their positions in relation to his arguments and conclusions, while his speculations constitute a common point of departure for the most curiously divergent developments of thought. To write the history of opinion in regard to his work would indeed be scarcely less than to write the history of biology, psychology, sociology, ethics, and political theory during the past thirty years. But it would be trite and therefore needless to dwell here on all these facts. It will be more to the point to seize the occasion offered by the closing of the Synthetic series to speak a little of the career and personality of the philosopher, and to outline in the broadest possible way some of the underlying principles of his organized system of thought.

The chief matters of importance in Herbert Spencer's externally uneventful life are by this time sufficiently well known to demand no more than the briefest recapitulation. Born in Derby, England, on the 27th of April, 1820, he came of a stock in which intellectual integrity, fearlessness, and independence were strongly pronounced characteristics. His father was by profession a teacher, holding views, however, of the aims and methods of education greatly in advance of the average scholastic theories of his time. It has been commonly said that it was owing largely to the child's precarious health that he was permitted to grow into boyhood without being subjected to the mental cramming and coercion then so much in vogue. The truth of the matter, however, is that he was not particularly delicate in early years, and that his father's wiser course of procedure was simply the result of experience, and of a dread of overtaxing the immature mind by the ordinary forcing system, to which he was totally

opposed.* Young Spencer was kept at home till he was just fourteen, thus reaping the advantage of his father's personal training and attention, and breathing an intellectual atmosphere unusually clear and stimulating. He was then placed in charge of his uncle, the Rev. Thomas Spencer, at that time perpetual curate of the parish of Hinton Charterhouse, near Bath. With this relative, who, it should be said, though an Episcopal clergyman, was a vigorous thinker and an energetic social reformer, he spent three years, making little of Greek Testament and Latin grammar, but manifesting extraordinary originality in the mathematical and mechanical studies to which a portion of his attention was devoted.

The design at this period entertained by Thomas Spencer, himself an academic honors man and to a certain extent an advocate of classical culture, of sending Herbert to Cambridge, was gradually relinquished as impracticable, and Spencer thus adds another to the long list of English leaders of thought who owe nothing directly to one or other of the great institutions of learning. On leaving Hinton the lad returned to his father's house, where he spent what was, to outward seeming, an idle and profitless year. Then, after a brief experiment in teaching, he made his real start in life in a profession to which the bias of his interests and the line of his studies alike pointed—that of the civil engineer. This was in the autumn of 1837. It was then the early days of the railroad excitement, and for a time the career he had chosen continued to offer a promising field. But presently the tide of activity ebbed gradually away, and after eight or ten years of intermittent work Spencer finally abandoned a calling in which he now saw little chance of substantial success, and thus at twenty-six found himself but slightly advanced toward a definite settlement in life.

Meanwhile, the expansion of his thought had already begun. At the age of twenty, while engaged on the Birmingham and Gloucester Railway, he had read Lyell's Principles of Geology, and had espoused what was then known as the Development Hypothesis; accepting the Lamarckian view (combated by Lyell) so far as to believe in the evolution of species, but rejecting all the great Frenchman's theories save that of the adaptation of the organism to its environment by the inheritance of acquired characters. His first piece of philosophical reasoning had also seen the light. In 1842 he had contributed to a paper called The Nonconformist a series of letters, subsequently revised and reissued in pamphlet form, on The Proper Sphere of Govern-

* In this and a few other matters I am able, through the kindness of Mr. Spencer himself, to correct not only some current misapprehensions, but also several errors of detail in the biographical chapter in my Introduction to the Philosophy of Herbert Spencer.

ment. In this early discussion of a question on which he was to have so much to say by and by, Spencer is to be found already vigorously insisting on "the limitation of state action to the maintenance of equitable relations among citizens."

After spending some time at home in what must have been a condition of great uncertainty, Spencer presently removed to London, where he secured an appointment on The Examiner newspaper, of which in 1848 he became subeditor. This position he held till 1853. In the meantime, in the intervals of comparative leisure afforded by the routine of his office work, he had written his first important book, Social Statics, published in 1850. Shortly after this he began his connection with the Westminster Review, to the pages of which, during the course of the next few years, he contributed a number of essays, valuable in themselves, and now particularly interesting as marking the development and consolidation of many of the fundamental elements of his later thought. In 1855 appeared a large volume on The Principles of Psychology (afterward incorporated into his more extended treatise on the same subject in the regular system); and in this book (be it remarked, four years before the publication of The Origin of Species) the problems of mind were throughout approached and discussed from the evolutionary point of view. It is probably due to the fact that Mr. Spencer had in this way pushed so far ahead of the most advanced thinkers of his generation that the Psychology, though respectfully received, attracted no widespread attention, and was certainly not regarded, even by specialists, as we regard it to-day, as a work of epoch-making character.

Almost simultaneously with the publication of this volume, and mainly as the direct result of overexertion in the writing of it, came Mr. Spencer's serious nervous breakdown, which for eighteen months incapacitated him for work altogether, and finally left him in that condition of semi-invalidism to which allusion has already been made. When, on partial restoration to health, he returned to his dropped undertakings, his first concern was to finish the essay on Progress, in which he expounded in detail that conception of evolution as a universal process which he had already reached in the Psychology. A year later (1858), he published a long defense of the Nebular Hypothesis; and it was during the preparation of this article that the scheme of the Synthetic Philosophy took shape in his mind. Hitherto, he had dealt with the phenomena of life and society in a fragmentary manner; now he realized the possibility of taking the doctrine of evolution as the basis of a system of thought, and of thus unifying knowledge by the affiliation of its various branches upon the ultimate laws underlying them all. The prospectus of the proposed enterprise

was drawn up in 1859, and distributed in the March of the following year.

The history of the man from this time on is almost entirely merged in the history of his work; the dates of importance for the outside world being those marked by the publication of the various portions and volumes of the promised series. Of Mr. Spencer himself, through all this long period during which the rare qualities of his genius have been more and more fully recognized, and the power of his thought has shown a steady growth, the public at large has known less perhaps than of any of his notable contemporaries. He has lived, rather by necessity than by choice, a very quiet and secluded life, saving all his available strength for the task he had set himself to accomplish; while, hating as he does the nauseating personalities of modern journalism, he has not only never courted notoriety, but has firmly resisted attempts frequently made to thrust notoriety upon him. This does not mean, and must not be taken to imply, that there is anything in him of the ascetic or recluse. He is by nature what Johnson described as a thoroughly "clubable" man enjoying so far as health would permit the *menus propos* of the dinner table, and social intercourse with congenial spirits. Himself a delightful conversationist and capital story-teller, fond of his joke, and with a ready laugh for the good sayings of others, he certainly does not remind those who are privileged to know him well of the dry, abstracted, unemotional philos pher of vulgar tradition, though doubtless a stranger would pronounce him cold and reserved. Before his nervous trouble assumed its more serious form a few years since, he took much pleasure in fishing, quoits, and especially billiards, and was a regular *habitué* of the Athenæum Club. But for a long time past these and similar amusements have been out of the question, and, being a rather impatient reader of general literature, he has derived his greatest solace from music, of which he has always been passionately fond. Without intruding, as I have no wish to do, upon the sanctities of private life, I feel that I am justified in saying this much, and in adding that in my own familiar relations with Mr. Spencer there is nothing that has impressed me more strongly than his lofty idea of rectitude, his fine sense of justice, and the transparency and charming simplicity of his character. Kind and considerate to those about him, despite the strain of insomnia and constant ill health, if he makes large demands upon the rationality and integrity of others, as he undoubtedly does, he claims no more from them than for his own part he is always ready to give. His standard of individual conduct is an extremely high one, but, unlike many theorists, he applies it to his own life as severely as he does to the lives of other people.

But it is time, turning from the man to his work, to proceed to the exposition of some of the fundamental principles of the Spencerian system of philosophy.

It is important, in the first place, to make clear the meaning which Mr. Spencer attaches to the word philosophy, as this will define for us the scope and purpose of his undertaking. By philosophy, then, to begin with a negative statement of his position, he does not understand an effort to solve the ultimate problem of the universe. He recognizes two categories—the Unknowable and the Knowable; and to the former of these, the proper domain of religion, he relegates all those final questions concerning Absolute Being, and the why and wherefore of the cosmos, which have largely absorbed the attention of the metaphysicians—questions which, owing to the conditions under which all our thinking has to be done, lie forever beyond the scope of human intelligence. The true subject-matter of philosophy, therefore, is not the problem of absolute cause and end, but of secondary causes and ends —not noumenal and unconditioned existence, but the manifestations of the noumenal in and through the co·ditioned and phenomenal. What, then, do we demand from philosophy? Not an explanation of the universe in terms of Being as distinguished from Appearance; but a complete co-ordination or systematic organization of those cosmical laws by which we symbolize the processes of the universe, and the interrelations of the various phenomena of which the universe, as revealed to us, is actually composed.* The old antithesis between common knowledge and what we call science, on the one hand, and philosophy on the other, forthwith disappears. They are not essentially unlike; their differences are differences of degree in generality and unification. "As each widest generalization of science comprehends and consolidates the narrower generalizations of its own division, so the generalizations of philosophy comprehend and consolidate the widest generalizations of science." Philosophy is thus presented as "the final product of that process which begins with a mere colligation of crude observations, goes on establishing propositions that are broader and more separated from particular cases, and ends in universal propositions. Or, to bring the definition to its simplest and clearest form: knowledge of the lowest kind is *ununified* knowledge; science is *partially unified* knowledge; philosophy is *completely unified* knowledge." †

Now, if philosophy is to undertake this complete unification of

---

* Here, and in a few other places in this brief outline, I have not scrupled to make use of the very phrases that I have employed in the more extended treatment of the same subject in my Introduction to the Philosophy of Herbert Spencer.

† First Principles, § 37.

knowledge, it must establish some ultimate proposition which includes and consolidates all the results of experience. It would obviously be infeasible in the space now at our disposal to follow Mr. Spencer step by step in the long and subtle argument by which this ultimate proposition is reached. We must content ourselves with the merest statement of results. Assuming, then, as we must ever continue to assume (for otherwise all thought would be impossible), that in the manifestations of the Unknowable in and through the phenomenal universe, congruities and incongruities exist and are cognizable by us, Mr. Spencer shows that in the last analysis all classes of likeness and unlikeness merge in one great difference—the difference between object and subject. "The profoundest distinction among the manifestations of the Unknowable," to quote his own words, "we recognize by grouping them into *self* and *not-self*." * His postulates, therefore, are "an Unknowable Power; the existence of knowable likenesses and differences among the manifestations of that Power; and a resulting segregation of those manifestations into those of subject and object." † From these postulates philosophy has to proceed to the achievement of its purpose as above set forth.

Pushing the argument through a consideration of space, time, matter, motion, force, the indestructibility of matter, and the continuity of force, Mr. Spencer at length reaches his ultimate dictum —the persistence of force; a dictum which possesses the highest kind of axiomatic certitude for two reasons: it constitutes the required foundation for all other general truths, and it remains stable and unresolvable—the one inexpugnable yet inexplicable element of consciousness. Force is thus, for Mr. Spencer, the ultimate conception, and the persistence of force furnishes the universal criterion of his system of thought. Of such persistence of force under the forms of matter and motion, all phenomena are necessary results. Eliminate this conception, and consciousness collapses. "The sole truth which transcends experience by underlying it, is thus the Persistence of Force. This being the basis of experience must be the basis of any scientific organization of experiences. To this an ultimate analysis brings us down, and on this a rational synthesis must build up." ‡

The first deduction drawn from this ultimate universal truth is that of the persistence of relations among forces—otherwise, the uniformity of law; whence we pass to the necessary corollaries, the doctrines of the transformation and equivalence of forces, and of the rhythm of motion. Both these principles are shown to hold good throughout the whole range of phenomena, from the physical and chemical to the psychical and social. These

* First Principles, § 44. † Ibid., § 45. ‡ Ibid, § 62.

truths, then, have the character of universality which constitutes them parts of philosophy, properly so called. "They are truths which unify concrete phenomena belonging to all divisions of Nature, and so must be components of that complete coherent conception of things which Philosophy seeks."* But none the less they are truths of the analytical order, and "no number of analytical truths will make up that synthesis of thought which alone can be an interpretation of the synthesis of things."† The problem now before us will be set in clearer light if we remember the relation, already stated, between the partially unified knowledge which we call science, and the completely unified knowledge which is the aim of philosophy. The various sciences advance from the resolution of their phenomena into the actions of certain factors, to the larger question—how from such combined actions result the given phenomena in all their complexity? They thus arrive at special syntheses. But such syntheses, even up to the most general, are more or less independent of one another. The business of philosophy, as now defined, is therefore to establish a universal synthesis comprehending and consolidating such special syntheses. "Having seen that matter is indestructible, motion continuous, and force persistent—having seen that forces are everywhere undergoing transformation, and that motion, always following the line of least resistance, is invariably rhythmic, it remains to discover the similarly invariable formula expressing the combined consequences of the actions thus separately formulated."‡

It is from this point that Mr. Spencer proceeds to reduce to systematic and comprehensive expression the laws of that continuous redistribution of matter and motion which is going on throughout the universe in general and in detail. All sensible existences, and the aggregates which they compose, have their history, and this history covers the entire period between their emergence from the imperceptible and their final disappearance again into the imperceptible. The redistribution of matter and motion which brings about this passage from the imperceptible, through the various stages of the perceptible, and back to the imperceptible, comprises two antagonistic processes: one characterized by the integration of matter and the dissipation of motion; the other by the absorption of motion and the disintegration of matter. The former produces consolidation and definiteness; the latter, diffusion and incoherence. These two universal antagonistic processes are evolution and dissolution. The entire universe is in a state of continual change, and it is in terms of these processes that all changes, small or great, inor-

* First Principles, § 89. † Ibid., § 90. ‡ Ibid., § 92.

ganic, organic, physical, vital, psychical, social, have to be interpreted.

In order to deprive the law of evolution, hereupon formulated, of any merely empirical character, Mr. Spencer shows at length that there are all-pervading principles underlying the all-pervading process. But of this reduction of inductive results to the deductive form we shall find it more convenient to speak presently when we come to deal with the general method of the Spencerian philosophy. Our immediate concern is to understand a little more clearly what we mean by evolution.*

We have already stated the matter in a broad and general way. Dissolution is disintegration; evolution is integration. But this definition takes note only of the primary element in the evolutionary process. Evolution means always an integration of matter and concomitant dissipation of motion, or, in other words, increasing coherence to definiteness; but it commonly implies much more than this. We must recognize the secondary changes by which this primary change is habitually complicated before the formula of evolution can be set down as complete.

These secondary changes are indeed the most conspicuous characteristics of the evolutionary process; and it is not surprising, therefore, that it was from these that Mr. Spencer started, that it was with these that he remained for a long time preoccupied, that it was these which he first defined in philosophic terminology. A simple plan for us to adopt in the present exposition will be to follow him very rapidly along the line of investigation by which the full law of evolution was gradually reached.

Approaching, as he did, the general problem of things by way of ethical and sociological inquiries, Mr. Spencer found himself confronted at the outset by the special fact of the development of man individually and in society—that is, with the fact of progress. What, then, is progress? This was the specific question to

* It is, of course, a necessary corollary from the doctrine of the rhythm of motion that the processes of evolution and dissolution are continually in conflict, locally and generally: and in no theory of the evolution of things—whether we consider individual existences, or aggregates of such, or the total aggregate that we call the cosmos—is it possible, therefore, to leave the process of dissolution out of the account. Individuals die, organisms disintegrate, societies collapse, races and civilizations are extinguished; while we are bound to acknowledge that for our earth itself, and the system of which it forms a part, and the universe in its entirety, the hour of dissolution must at length be sounded—the disintegrating force must finally begin to undo the work of eons upon eons of slow and gradual integration. In the life and death of a gnat we find a tiny symbol of the pulsations that produce the rise and decay of worlds. But in our own system and on our planet, however certain the ultimate course of things may seem to be, the process of evolution has long predominated, and still predominates, over the process of dissolution; and it is upon the former process, therefore, that we fix attention, though the rhythm of motion and the flux of existence reveal themselves wherever we look.

which, for a number of years, he was slowly feeling his way to an answer. In his earliest publication—the Letters on the Proper Sphere of Government—there was already implied the belief that societies are not manufactured, but grow; and it was from the side of natural law, therefore, that this question of progress was at once approached. It was in the pages of Social Statics that he elaborated his first reply. There, borrowing from Coleridge the theory that Coleridge in turn had derived from German speculation—that life is "a tendency toward individuation"—he undertook to show that it is in the fulfillment of this tendency that all progress will be found to consist. Individuation, then, was the master-principle of his thought. But, examined closely, this tendency toward individuation resolves itself into two closely related processes: one making for more and more sharply defined separateness; the other for increasing unity of organization. Universal specialization, with resulting development of complexity, represents one side of the movement we call progress; increasing interdependence among the specialized parts of the organism represents the other.

Progress, therefore—or, to substitute the proper word, evolution—was already recognized by Mr. Spencer as a double-sided process, comprising differentiation, with consequent growth in complexity, and integration, with consequent growth in unification. But though this second-named element—unification—was never entirely lost sight of by him, and is given clear statement, for example, in the essays on The Philosophy of Style and The Genesis of Science, it was upon the former element—differentiation—that for a time his attention was fixed. Taking this principle by itself, and detaching it from all other considerations, he attempted, in his essay on Progress: its Law and Cause, to expand it into a complete theory of universal evolution. In this he was helped by von Baer's law, with which he had become acquainted in 1852—"that the series of changes gone through during the development of a seed into a tree, or an ovum into an animal, constitute an advance from homogeneity of structure to heterogeneity of structure." Overlooking the principle of integration, Mr. Spencer announces this generalization as his text. "We propose," he writes, in the early part of his essay, "to show that this law of organic progress is the law of all progress." In other words, evolution is made to consist wholly in the increase of complexity—in the transformation of the homogeneous into the heterogeneous by successive differentiations.

Satisfied that he had now reached not only *a* law of evolution, but also *the* law of evolution, Mr. Spencer, when he began work on the Synthetic Philosophy, proceeded to elaborate his thesis in the first edition of First Principles. Further thought, however,

convinced him that he had fallen into error—that the transformation of the homogeneous into the heterogeneous does not sum up the whole of evolution, but only the most conspicuous part of the secondary redistribution of matter and motion constituting it. Many changes in the direction of increasing heterogeneity—e. g., the rise of a cancer in the individual organism, or of a revolution in the state—obviously tend not to evolution, but to dissolution. When, then, does increase in complexity mean evolution? The answer to this question, found in a return to the principle of integration, is, when increase of complexity is accompanied by more and more complete interdependence among the specialized parts—by increase in organic unification. Evolution, therefore, may be roughly defined as change toward multiformity in unity, brought about by the rise of unlikenesses (differentiation) and the concentration of the unlike parts, through mutual dependence, into an organized whole (integration); or, to phrase the doctrine philosophically in Mr. Spencer's world-famous formula, as "an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity, and during which the retained motion undergoes a parallel transformation."

But with the formulation of this all-pervading process, we reach only the starting-point of a fresh investigation. Philosophy—the complete unification of knowledge—demands the restatement of the law of evolution in deductive form. Such being the transformations manifested by all classes of concrete phenomena, we ask, Why this continuous metamorphosis? We must seek the *rationale* of the universal changes inductively set forth, must undertake to interpret them as necessary consequences of some deeper law.

Incidentally we may notice here the firm, logical consistency of the Spencerian system. While it presents us with a history of the knowable universe in empirical generalizations, it also affiliates these all-embracing generalizations upon ultimate principles, derives them from its final dictum, and thus furnishes a rational history of the knowable universe as well. Undertaking, therefore, the task of presenting the phenomena of evolution in synthetic order, Mr. Spencer arrives at the law of the instability of any finite homogeneous aggregate owing to the unequal exposure of its parts to incident forces, and proceeds to show, first, that "every mass, or part of a mass, on which a force falls subdivides and differentiates that force, which thereupon proceeds to work a variety of changes"; and, secondly, that the process of segregation, "tending ever to separate unlike units and to bring together like units," serves constantly "to sharpen or make definite differentiations otherwise caused." Finally, these laws—the instability

of the homogeneous, the multiplication of effects, and segregation—are exhibited as corollaries from the ultimate law, as inevitable results of the persistence of force under its forms of matter and motion. In this way the circle of induction and deduction is made complete.

In this connection it will be interesting to say something about the course of thought by which Mr. Spencer was gradually led to the fundamental principles above summarized. I am fortunate in having before me as I write a letter in which he was kind enough to outline for me the important stages in his progress toward the great doctrines of the synthetic philosophy.* If, in following his account and in occasionally reproducing, as I shall venture to do, his own words, I am forced to touch again upon points already brought out, this will scarcely be deemed ground for regret, since the slight repetition involved will serve perhaps to throw the whole subject into clearer relief.

The simple nucleus of his philosophic system first made its appearance in Social Statics, where, in the chapter entitled General Considerations, mention is made of the biological truth that low types of animals are composed of many like parts not mutually dependent, while higher animals are composed of parts that are unlike and are mutually dependent. This, he writes, "was an induction which I had reached in the course of biological studies—mainly, I fancy, while attending Professor Owen's lectures on the Vertebrate Skeleton." With this was joined the statement that the same is true of societies, "which begin with many like parts not mutually dependent and end with many like parts that are mutually dependent." This also was an induction. "And then in the joining of these came the induction that the individual organism and the social organism followed this law." Thus the radical conception of the entire system took shape before Mr. Spencer had become acquainted with von Baer's law, which, as we have seen, did not occur till two years later. This law, though applying to the unfolding of the individual only, had none the less its use. In furnishing the expression "from homogeneity to heterogeneity," it presented a more convenient intellectual implement. "By its brevity and its applicability to all orders of phenomena, it served for thinking much better than the preceding generalization, which contained the same essential thought." The essays which followed Social Statics were marked by the establishment of various separate inductions in which other groups of

* In this letter Mr. Spencer called my attention to the fact that certain paragraphs in my Introduction (chapter iii, § ii) would, taken by themselves, be likely to leave the reader with a mistaken impression of the philosophic method pursued by him. For this reason I am glad to have the opportunity of returning to the matter here.

phenomena were brought under this large principle, while in the first edition of the Psychology not only was this same principle shown to comprehend mental phenomena, but there was also recognized the primary law of evolution—integration and increase of definiteness. What followed may best be given in Mr. Spencer's own words: "Then it was that there suddenly arose in me the conception that the law which I had separately recognized in various groups of phenomena was a universal law applying to the whole Cosmos: the many small inductions were merged in the large inductions. And only after this largest induction had been formed did there arise the question—Why? Only then did I see that the universal cause for the universal transformations was the multiplication of effects, and that they might be deduced from the law of the multiplication of effects. The same thing happened at later stages. The generalization which immediately preceded the publication of the essay on Progress: its Law and Cause—the instability of the homogeneous—was also an induction. So was the direction of motion and the rhythm of motion. Then having arrived at these *derivative* causes of the universal transformation, it presently dawned upon me (in consequence of the recent promulgation of the doctrine of the conservation of force) that all these derivative causes were sequences from that universal cause. The question had, I believe, arisen, Why these several derivative laws? and that came as the answer. Only then did there arise the idea of developing the whole of the universal transformation from the persistence of force. So you see the process began by being inductive and ended by being deductive; and this is the peculiarity of the method followed. On the one hand, I was never content with any truth remaining in the inductive form. On the other hand, I was never content with allowing a deductive interpretation to go unverified by reference to the facts."

It remains for us now, so far as space will permit, to pass in rapid review a few of the most salient features of the evolutionary philosophy thus wrought into a firmly knit, logical whole—a philosophy which, as a science of the sciences resting upon universal law, is properly called Synthetic.*

To the exposition and elaboration in their broadest aspects of the all-comprehensive truths above epitomized, Mr. Spencer devotes the initial volume of his series—First Principles. Such a presentation of arguments and results constitutes what he defines

---

* Readers who desire to know something of Mr. Spencer's reasons for the selection of the term Synthetic Philosophy as the general title of his system will find a good deal of information in Mr. John Fiske's extremely interesting life of Edward Livingston Youmans. See especially pages 233, 290, and 291.

as General Philosophy. The nine following volumes of the system are devoted to Special Philosophy—that is, to the task of carrying these universal truths, as an organon, forward into the particular phenomena which form the subject-matter of biology, psychology, sociology, and ethics, and of interpreting such particular phenomena by them.

Strictly speaking, of course, at the very opening of this serial undertaking a large gap remains unfilled, since the application of the fundamental principles already established should first of all be made to inorganic Nature. But this great division is passed over entirely, "partly," to quote the words of the prospectus, "because, even without it, the scheme is too extensive; and partly because the interpretation of organic Nature after the proposed method is of more immediate importance." We thus enter at once, in The Principles of Biology, the field of organic life; the purpose of the two volumes composing this work being, as stated in the preface, "to set forth the general truths of biology as illustrative of and as interpreted by the laws of evolution." Due notice should be taken of the phrase here employed—"the general truths of biology." To write a detailed and exhaustive treatise on the subject was manifestly no part of Mr. Spencer's plan, which called only for such a co-ordination and synthesis of fundamental principles as, expressed in terms of the universal laws of the redistribution of matter and motion, and finally affiliated upon the ultimate truth, the persistence of force, would present in broadest outline the science of life.

From the historical point of view no part of this masterly work is of greater interest than the closing division of the first volume, in which Mr. Spencer, after dismissing the special-creation theory of things as untenable, displays at length the *a priori* and *a posteriori* evidences of organic evolution. To appreciate the full significance of his arguments, it is necessary to remember that at the time when the chapters containing them were written, the doctrine of development was currently regarded, even by the large body of naturalists, as a more or less fantastic hypothesis. But while thus presenting the case for evolution in its inductive and deductive aspects, Mr. Spencer did much more than this. He showed that the processes observable in the world of organic life are but phases of the universal cosmical processes formulated in First Principles; and that thus the deepest laws of morphological and physiological development are, deductively viewed, necessary corollaries from the doctrines already established. Even the Darwinian principle of natural selection (or, as Mr. Spencer called it, the survival of the fittest in the struggle for existence) is exhibited as falling into its place as a single manifestation of a far wider law—the law of equilibration.

As here developed in its biological aspects, this law of equilibration* deserves the closest attention. Life is defined by Mr. Spencer as "the continuous adjustment of internal relations to external relations"; and he shows that the degree of life varies as the correspondence varies between organism and environment; the highest point being reached where the correspondence exhibits a maximum of complexity, rapidity, and length. Lack of correspondence—that is, inability on the part of an organism to balance external actions by internal actions—means death; absolutely perfect adjustment, on the other hand, would be absolutely perfect life. Now, equilibration, biologically considered, expresses the tendency on the part of an organism to adapt itself to its environment, the environment itself being, it must be remembered, in a state of constant change; and such equilibration is *direct* where the organism responds immediately to the demands of its surroundings, and *indirect* where variations which are in the line of greater correspondence are gathered up and transmitted to following generations. Under the one head, it is manifest, we formulate the doctrine of use and disuse; under the other, the doctrine of natural selection. Nor is this all. Followed through its wider sweep of meaning, the law of equilibration is found to throw a flood of fresh light on the vexed question of population. Individuation and genesis are in necessary antagonism; and while "excess of fertility has itself rendered the process of civilization inevitable," the process of civilization must in turn "inevitably diminish fertility, and at last destroy its excess."† Gradual approach will thus be made toward an equilibrium "between the number of new individuals produced and the number which survive and propagate."‡

From The Principles of Biology we pass to The Principles of Psychology, the massive superstructure of which is firmly reared on the general foundations already laid. Life at large is the genus; what we distinguish as bodily life and mental life respectively are species; and though if, after the ordinary fashion, we insist on contemplating only the extreme forms of the two, it would appear that the hardest line of demarcation is to be drawn between them, such line necessarily vanishes the moment the evolutionary point of view is assumed. Acceptance of this point of view, furthermore, enables us to realize that mind can be understood only in the light of its evolution. "If creatures of the

* The general law is worked out in full in First Principles (Part II, chapter xxii). The question is there raised, Can the changes constituting evolution go on without limit? And the answer is, No. "The changes go on until there is reached an equilibrium between the forces which all parts of the aggregate are exposed to, and the forces these parts oppose to them."

† Principles of Biology, § 376.

‡ Ibid., § 377.

most elevated kinds have reached those highly integrated, very definite, and extremely heterogeneous organizations they possess, through modifications upon modifications accumulated during an immeasurable past—if the developed nervous systems of such creatures have gained their complex structures and functions little by little; then, necessarily, the involved forms of consciousness which are the correlatives of these complex structures and functions must have arisen by degrees. And as it is impossible truly to comprehend the organization of the body in general, or of the nervous system in particular, without tracing its successive stages of complication; so it must be impossible to comprehend mental organization without similarly tracing its stages." *

As in The Principles of Biology the general truths of life were interpreted through the fundamental laws of evolution, so, therefore, in The Principles of Psychology the general facts and problems of mind are elucidated in the same way. The work opens with a consideration of data and inductions, and then—given the psychical shock which Mr. Spencer distinguishes as the primordial and unresolvable element, or ultimate unit, of consciousness—proceeds to trace the evolution of intelligence, stage by stage, through reflex action, instinct, memory, reason, the feelings, and the will. This progress is then exhibited as part of evolution at large; the phenomena belonging to the intellectual, as contradistinguished from the emotional life, are examined in detail; and the ultimate question of the relation between thought and things—between subject and object—is raised and dealt with. Finally, a number of extremely suggestive chapters are devoted to corollaries concerning the expression of feeling, sociality and sympathy, egoistic, ego-altruistic, and altruistic sentiments, and the evolution of æsthetic activities and gratifications—all these matters being of great importance in the synthetic system as developing that special part of human psychology upon which sociology and ethics must rely for their foundations.

With the way thus prepared, Mr. Spencer enters upon what, quantitatively considered, represents by far the largest portion of his undertaking—the application of the laws of evolution to the phenomena of society. The Principles of Sociology as actually completed exhibit the only important departure of the author from the prospectus issued thirty-six years ago; for the volume in which linguistic, intellectual, moral, and æsthetic progress was to have been traced out, is left unwritten. Sundry of the more momentous questions connected with these phases of human development, however, are touched upon in other parts of the system, and the hiatus is, therefore, by no means a serious one.

* Principles of Psychology, § 129.

On the other hand, the remaining divisions of the work have, in the writing, undergone unlooked-for expansion; the three bulky volumes now before us containing, in addition to nearly six hundred pages setting forth data and inductions, elaborate treatises on domestic, ceremonial, political, ecclesiastical, professional, and industrial institutions, their genesis, growth, characteristics, significance, and probable future developments.

Of the direct bearings of these volumes upon the urgent problems of modern social life, this is, unfortunately, not the place to speak; though we may note in passing that here, as elsewhere, the Spencerian philosophy reveals its eminently practical qualities. No matter to what profound depths its arguments may take us, its doctrines relate themselves at every point with vital issues, and thus, in Lord Bacon's phrase, come home to men's business and bosoms. We feel, in following its speculations, that, remote and labyrinthine as these must necessarily sometimes seem to be, we are never, after all, very far away from the broad highway of human affairs. But if we must not now dwell upon this particular point, still less must we allow ourselves, in connection with it, to be drawn off into any discussion of Mr. Spencer's individualism.* We must confine ourselves to the merest statement of the purpose of the Sociology, taken as a whole.

Such purpose is, of course, in a word, the interpretation of the phenomena of social growth and organization, from the simplest to the most intricate, in terms of universal evolution. Societies are organisms—evolving aggregates; and their progress is clearly marked by even greater and greater multiformity in unity—that is, by gradual advance from the comparative homogeneity, indefiniteness, and incoherence of the simple tribe, to the constantly increasing heterogeneity, definiteness, and coherence of the civilized nation. To work out this continuous process of integration and differentiation along the great lines of social structure and function; to make clear that the transformations everywhere going on, from the minutest change in a tribal group to the far-reaching metamorphoses of modern civilization, are at bottom exemplifications of the ultimate laws of evolution; and to show that the complex play of forces in the superorganic, no less than in the organic, world tends inevitably toward equilibration; in such a general consensus of results, then, the various detailed portions of the Sociology all merge; in such a consensus the fun-

* I may perhaps be allowed to refer the reader who is interested in this special matter to the chapter on The Spencerian Sociology in my Introduction. I there endeavored to show that Mr. Spencer's political views grow naturally out of the body of his thought, and constitute an essential part of his general doctrine of evolution. The subject is a vast one for brief treatment, and I was, therefore, the more gratified when Mr. Spencer expressed entire satisfaction with my analysis of his arguments and conclusions.

damental connecting link is to be found between the work in its totality and the other divisions of the Synthetic Philosophy.

One large aspect of universal evolution remains to be considered before the organization of knowledge demanded by philosophy can be taken as complete; and this aspect—of such importance as to lead Mr. Spencer to describe all other parts of his work as subsidiary to its interpretation *— we at length reach in the concluding two volumes of the series comprising The Principles of Ethics. To the student of the earlier divisions of the Spencerian system the point of view adopted in the elucidation of the facts and problems of conduct will appear a matter of course. Ethics necessarily depends upon the simpler sciences, and generalizations furnished by these must be accepted as data for the systematization of the principles of right living. Moreover, conduct at large, including those portions of it which form the subject-matter of morality, can be fully understood only when regarded as one phase of evolving life. This conception of things will now seem so natural as to call for nothing beyond the baldest statement.

In his work of reconstructing ethical theory along the lines thus indicated, and in harmony with the fundamental doctrines of his philosophy, Mr. Spencer takes a great and most important step in advance of the results reached by the various schools of scientific moralists in the past. His system is, of course, hedonistic or utilitarian—that is, the final criterion and ultimate end of conduct is for him happiness, pleasure, or well-being. But he was naturally discontent with the merely empirical conclusions in which the older utilitarians had been willing to rest. They had not pushed beyond the inductive stage of inquiry; and their generalizations, however interesting and valuable they might be, were merely generalizations after all—statements founded simply upon accumulated observations of results. But, though every science begins with such observations and generalizations, it has no claim to be considered a developed science until the principle of causation is fully recognized and inductive results are set forth in deductive form. It is the scientific presentation of ethical principles, in this strict sense of the word scientific, that Mr. Spencer has, therefore, undertaken. He has sought to convert the laws of conduct from truths of the empirical into truths of the rational order. As he wrote in his letter to Mill: † "I conceive it to be the business of moral science to deduce from the laws of life and the conditions of existence what kinds of action necessarily tend to produce happiness and what kinds to produce

* See original preface to The Data of Ethics (1879).

† Reprinted in The Principles of Ethics, § 21.

unhappiness. Having done this, its deductions are to be recognized as laws of conduct, and are to be conformed to, irrespective of a direct estimation of happiness or misery."

If it is asked toward what general conclusions regarding the moral prospects of the race the Spencerian ethics may be said to point, the broadest answer will be found in the statement of the universal law, already frequently referred to—the law of equilibration. We bring with us into life instincts and impulses which we derive from our long line of animal and barbarous ancestry: our natures are very imperfectly adjusted to the demands of social life. But the influences of advancing civilization have throughout human evolution been gradually molding character into more and more complete harmony with the sum-total of the conditions under which we live. Hence we may anticipate a time, far distant though it must needs be, when the internal forces which we know as feelings will be in fairly perfect balance with the external forces which they encounter; when, in other words, the nature of man will have become fully adapted to the associated state. Mr. Spencer has, indeed, within recent years spoken less optimistically about this consummation than he did when, in Social Statics, he asserted the evanescence of evil. But he still looks forward to an "approximately complete adjustment" * of constitution to conditions as the goal of moral evolution, toward which we are actually, if slowly, moving.

And now, even in so slight a sketch as this, we can not leave the synthetic system without broaching one last issue of the profoundest importance. What are the bearings of the Spencerian philosophy upon the ultimate questions of religion?

We have seen that on the very threshold of his undertaking Mr. Spencer cleared the way for constructive effort by defining philosophy as knowledge of the highest generality, and thus asserting its limitations within the sphere of the phenomenal. Ontological speculations are thus abandoned, and our concern is not with the absolute, the unconditioned, the infinite, but with the relative, the conditioned, the finite. We have seen, furthermore, that in the application of the universal laws of evolution to the various phenomena of the sciences we have to seek the final interpretation of even the highest manifestations of psychical life in terms of matter, motion, force. To what general conclusions do we thus seem to stand committed? Surely, it may be urged, there is but one inference possible. Our philosophy is a philosophy of materialism pure and simple.

Such an inference, however, though often loudly proclaimed by the ignorant and the perverse, is one that the careful student,

* The Principles of Ethics, § 244.

recalling the many luminous passages in which Mr. Spencer has stated and restated his position, will of necessity refuse to indorse. So frequently, indeed, has our author repudiated, not by phrases only, but by arguments, the charges made against him on this popular count, that repetition of them must be taken to imply either oversight, or misconception, or deliberate attempt to force upon him, for polemical purposes, opinions which he has consistently disowned and even vigorously opposed. How, then, we may ask, turning directly to his own writings, does the case really stand?

Briefly thus. The chemist can not explain the ultimate nature of matter, nor the physicist the ultimate nature of motion, nor the psychologist the ultimate nature of mind. Matter, motion, mind are but symbols, expressing for us the manifestations of an unknown power, and, pushed to the utmost limits of simplification, the symbols remain symbols still. The question at issue between spiritualists and materialists, therefore, viewed from the Spencerian standpoint, resolves itself into a question of these symbols, and any answer that can conceivably be given leaves us as completely outside the reality as we were at first. Spirit and matter must thus be regarded simply as signs of the ultimate existence which underlies both; and though we may lean to the spiritualistic rather than to the materialistic side—though of the two it may seem "easier to translate so-called matter into so-called spirit than to translate so-called spirit into so-called matter (which latter is indeed wholly impossible"*), yet we must remember that no such translation will carry us beyond our symbols into a knowledge of that for which they stand.

Manifestly, then, the absolute and unconditioned existence which transcends human intelligence and in which the subject, object, spirit, matter of our finite consciousness merge and are united, is not for Mr. Spencer mere zero—a negation of thought. It is a positive fact of the profoundest certitude; or rather let us say it is *the* final fact sustaining all others—the fact which science finds at the back of its widest generalizations and beneath its deepest truths. And this final fact of science, this ultimate datum of consciousness, upon which all knowledge depends, this cause of all causes in the universe as it is revealed to us, is the permanent foundation of all religion as well. Here the ancient foes meet in complete reconciliation. Science must necessarily end in the mystery with which religion begins. "That which persists unchanging in quantity but ever changing in form," under the sensible appearances "which the universe presents to us," is an "unknown and unknowable power which we are obliged to recog-

* The Principles of Psychology, § 63.

nize as without limit in space and without beginning or end in time," and this noumenal power of philosophy, of which all phenomena are but manifestations, is the God of religion—"the infinite and eternal energy from which all things proceed."

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

I.—LANGUAGE, NATIONALITY, AND RACE.

THE historian of The Norman Conquest of England was very fond of contrasting the east and the west of Europe. He maintained that the political unrest which underlies the Eastern question was due to the utter lack of physical assimilation among the people of the Balkan states; that, in other words, nationality had no foundation in race. This was undoubtedly true to some extent; and yet even in the west, the formation of these boasted nationalities is so recent that it accords but slightly with the lines of physical descent. A slight scratch of the skin of neighbors suffices to reveal radical differences of blood, so that the west is merely a step in advance of the east after all. It is a trite observation that all over Europe population has been laid down in different strata more or less horizontal. In the east of Europe this stratification is recent and distinct. West of the Austro-Hungarian Empire the primitive layers have become metamorphosed, to borrow a geological term, by the fusing heat of nationality and the pressure of civilization. The population of the east of Europe structurally is as different from that of the west to the naked eye as, to complete our simile, sandstone is from granite; nevertheless, despite their apparent homogeneity on analysis we may still read the history of these western nations by the aid of natural science from the purely physical characteristics of their people alone.

To the ordinary observer a uniform layer of population is spread over the continent as waters cover the earth. In reality, while apparently at rest, this great body of men reveals itself today in constant motion internally. Currents and counter-currents sweep hither and thither, some rising and others falling, with now and then a quiet pool or eddy where alone population is really in a quiescent state. These movements are not transient; they have been going on for centuries, determined by the economic character and the geography of the continent. They are

shifting suddenly now with modern industrial life, but they have persisted until the present through generations. Proof of this antiquity we have; where Nature has isolated little pools since, of population, we may still find men with an unbroken ancestral lineage reaching back to a time when the climate, the flora and fauna of Europe were far different from those which prevail to-day. This may be shown, not by historical documents, for these men antedate all written history, but by physical traits which are older than institutions and outlast them all as well.

This varied population, as we see it to-day, is in its racial composition the effect of a long train of circumstances, historical upon the surface, social it may be in part, but at bottom also geographical. From these effects, and from the migrations even now going on, we may seek out the causes—many of which have hitherto been neglected by students of institutions—which have been operative for centuries, and which have gone on in spite of political events or else have indirectly given rise to them. Progress in social life has not been cataclysmic; it has not taken place by kangaroo-leaps of political or social reforms on paper; but it has gone on slowly, painfully perhaps, and almost imperceptibly, by the constant pressure of slight but fixed causes. Our problem is to examine certain of these fundamental mainsprings of movement, especially the influence of the physical environment; and to do it by means of the calipers, the measuring tape, and the color scale. Science proceeds best from the known present to the remote past, in anthropology as in geology or astronomy. The study of living men should precede that of the dead. This shall be our method. Fixing our attention upon the present population, we shall then be prepared to interpret the physical migrations and to some extent the social movements which have been going on for generations in the past.

Let us at the outset avoid the error of confusing community of language with identity of race. Nationality may often follow linguistic boundaries, but race bears no necessary relation whatever to them. Two essentials of political unity are bound up in identity of language—namely, the necessity of a free interchange of ideas by means of a common mental circulating medium; and, secondly, the possession of a fund of common traditions in history or literature. The first is largely a practical consideration; the second forms the subtle essence of nationality itself. For these reasons we shall find language corresponding with political affiliations far more often than with ethnic boundaries.* Politics

* A full discussion of this point is offered in Bulletin de la Société d'Anthropologie, Paris, 1862, p. 264. *Vide* also Journal of the Anthropological Institute, vol. v, p. 212; and Mittheilungen der anthropologischen Gesellschaft, Wien, Supp. I, p. viii.

may indeed become a factor in the physical sense, especially when re-enforced by language. It can not be denied that assimilation in blood often depends upon identity of speech, or that political frontiers sometimes coincide with a racial differentiation of population. The canton of Schaffhausen lies north of the Rhine, a deep inset into the grand duchy of Baden, yet its people, though isolated from their Swiss countrymen across the river, are intensely patriotic. In race as in political affairs they are distinctly divided from their immediate German neighbors. Mentally holding to the Swiss people, they have unconsciously generated a physical individuality akin to them as well. Thus it is possible that a sense of nationality once aroused may become an active factor through selection in the anthropological sense. Nevertheless, this phenomenon requires more time than most political history has at its disposition, so that in the main our proposition remains true. Despite the political hatred of the French for the German, no appreciable effect in a physical sense has yet resulted, nor will it until the lapse of generations.

Consideration of our linguistic map of the southwest of Europe will serve to illustrate some of the potent political influences which make for community of language without thereby indicating any influence of race. The Iberian Peninsula, now divided between two nationalities, the Spanish and the Portuguese, is, as we shall subsequently show, in the main homogeneous racially—more so, in fact, than any other equally large area of Europe. The only exception is in the case of the Basques, whom we must consider by themselves. This physically uniform population, exclusive of the Basque, makes use to-day of three distinct languages, all Romance or Latin in their origin, to be sure, but so far differentiated from one another as to be mutually unintelligible. It is said, for example, that the Castilian peasant can more readily understand Italian than the dialect of his neighbor and compatriot, the Catalan. The gap between the Portuguese and the Castilian or true Spanish is less deep and wide, perhaps; but the two are still very distinct and radically different from the language spoken in the eastern provinces of Spain. The Catalan speech is, as the related tints upon our map imply, only a sub-variety of the Provençal or southern French language. The people of the Balearic Islands speaking this Catalan tongue differ from the French in language but little more than do the Corsicans.*

---

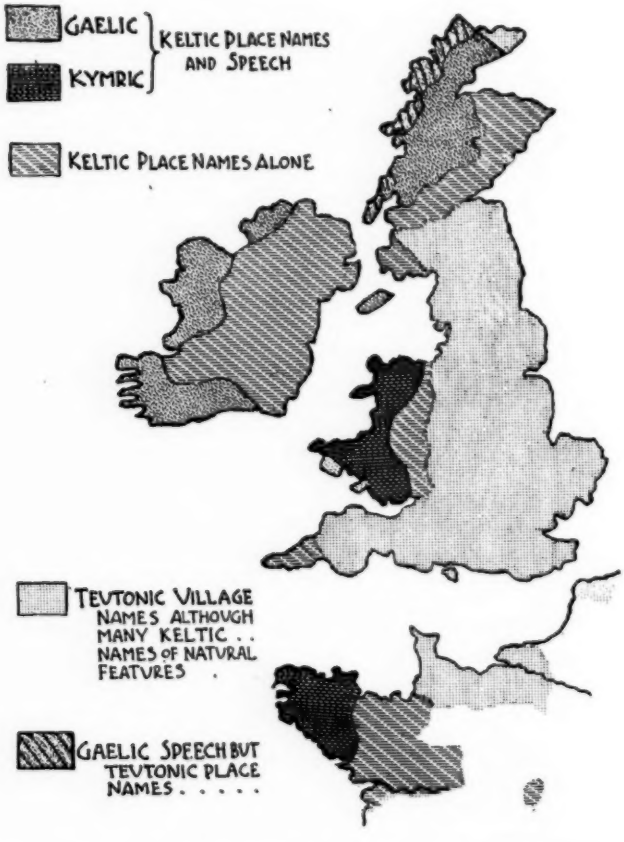
* For the Basque language boundary, *vide* Revue d'Anthropologie, Paris, series 1, iv, p. 1. The Catalan boundary in France is mapped in Revue mensuelle de l'École d'Anthropologie, Paris, vol. i, p. 143; Encyclopædia Britannica, vol. xxii, p. 350, gives details for Spain. The dialect boundary of the Langue d'Oc is traced geographically in Revue mensuelle, etc., i, p. 219; *vide* also Bulletin de la Société d'Anthropologie, 1879, p. 68.

At first glance all this seems to belie our assertion that unity of language is often a historical product of political causes. For it may justly be objected that the Portuguese type of language, although in general limited by the political boundary along the east, has crossed the northern frontier and now prevails throughout the Spanish province of Galicia; or again, that the French-Spanish political frontier has been powerless to restrain the advance, far toward the Strait of Gibraltar, of the Catalan speech, closely allied as we have said to the dialects of Provence

in southern France; that not even the slight line of demarcation between these last two lies along the Pyrenean political boundary, but considerably to the north of it, so that Catalan is to-day spoken over nearly a whole department in France; and, lastly, that the Basque language, utterly removed from any affiliation with all the rest, lies neither on one side nor the other of this same Pyrenean frontier, but extends down both slopes of the mountain range, an insert into both national domains of France and Spain. These objections are, however, the very basis of our contention that language and nationality often stand in a definite relation to one another: for, if we examine the history of Spain

and Portugal, we shall discover that historical causes alone have determined this curious linguistic distribution.

The three great languages in the Iberian Peninsula—Castilian or Spanish, Portuguese, and Catalan—correspond respectively to the three political agencies which drove out the Moorish invaders from the ninth century onward from three different directions and from distinct geographical centers. The mountains of Galicia, in the extreme northwest, served as the nucleus of the resistant power which afterward merged itself in the Portuguese


GAELIC
KYMRIC
KELTIC PLACE NAMES AND SPEECH
KELTIC PLACE NAMES ALONE
TEUTONIC VILLAGE NAMES ALTHOUGH MANY KELTIC .. NAMES OF NATURAL FEATURES
GAELIC SPEECH BUT TEUTONIC PLACE NAMES . . . . .

monarchy. Castile in the central north was the asylum of the refugees, expelled from the south by the Saracens, who afterward reasserted themselves in force under the leadership of the kings of Castile. Aragon in the northeast, whose people were mainly of Catalan speech, which they had derived from the south of France, during their temporary forced sojourn in that country while the Moors were in active control of Spain, was a base of supplies for the third organized opposition to the invaders. Each of these political units, as it reconquered territory from the Moors, im-

posed its official speech upon the people, where it remains to-day. Were the present Spanish nation old enough and sufficiently unified; were the component parts of it more firmly knitted together by education, modern means of transport, and economic interests; this disunity of speech might disappear. Unfortunately, the character of the Iberian Peninsula is such—arid, infertile, and sparsely populated in the interior—that these languages socially and commercially turn their backs to one another. Of necessity, they do this also along the frontier between Spain and Portugal. The eyes of each community are directed not toward Madrid, but toward the sea; for there on the fertile littoral alone, is there the economic possibility of a population sufficiently dense for unification. Thus the divergence of language is truly the expression of natural causes working through political ones, which promise to perpetuate the differences for some time. As for the Basques, they have been politically independent both of the French and the Spaniards until within a few years, and have been enabled to preserve their unique speech largely for this reason. But now that their political autonomy has begun to disappear, the official Spanish is pressing the Basque language so forcibly that it seems to be everywhere on the retreat.

We have seen that community of language is often imposed as a result of political unity. But it is, after all, rather a by-product, so that it often fails even here to indicate nationality. Its irresponsibility in respect both of nationality and of race is clearly indicated by the present linguistic status of the British Isles.* As our map shows, the Keltic language is now spoken in the remote and mountainous portions of Wales, Scotland, and Ireland, as well as across the English Channel in French Brittany. Are we to infer from this that in these several places we have to do with vestiges of a so-called Keltic race which possesses any physical traits in common? Far from it! For, although in a few places racial differences occur somewhere near the linguistic frontiers, as in Wales and Brittany, they are all the more misleading elsewhere for that reason. Within the narrow confines of this spoken Keltic language are to be found populations characterized by all the extremes of the races of Europe. The dark-haired, round-faced Breton peasant speaking the Kymric branch of the Keltic tongue is, as we shall hope to demonstrate, physically as far removed from the Welshman who uses the same language, as from the tall and blue-eyed Norman neighbor in France

* For exact details and maps of the spoken languages, *vide* Ravenstein in Journal of the Royal Statistical Society, London, vol. xlii, p. 579, for Great Britain. The limits in France are mapped in Mémoires de la Société d'Anthropologie, Paris, series i, iii, pp. 147 *seq.* The place names are mapped in Canon Taylor's Names and Places. Also Bull. Soc., 1878, p. 236.

who knows nothing of a Keltic speech at all. The Welshman in turn is physically allied to the Irish and distinct from many of the Gaelic-speaking Scotch, although these last two speak even the same subtype of the Keltic language. Such racial affinity as obtains between certain of these people is in utter defiance of the bonds of speech. The Breton should be more at home among his own folk in the high Alps in respect of race, even although he could hold no converse with the Swiss people in their own tongue.

If these examples be not enough, turn to other parts of Europe. The Walloons and the Flemish, component parts of the Belgian nation, are indeed quite distinct in race and in language alike.* It is only an accident. For if we turn to Switzerland, seeking for physical differences along the boundary of the French- and German-speaking cantons, they are not to be found.† In northern Italy to-day there are considerable communities still bearing the German speech and customs, evidence of the Teutonic invasions of historic times. These people have become so completely absorbed that they are not distinguishable physically from their Italian neighbors. There are indeed spots in Italy where German racial traits survive, but they are quite remote from these islets of Teutonic language.‡

Nor in eastern Europe is the picture less confusing. The Bulgarian language, spoken by people so outlandish to Europeans that they gave the word "bogie" to our nurses wherewith to frighten children, went first. Now it is the Roumanian speech which, in its turn, is disappearing before the Slavic tongue.# Magyar, the language of the Hungarians, spreading toward the east, displaced by German, which is forcing its way in from the northwest, is also on the move. Beneath all this hurry-skurry of speech the racial lines remain as fixed as ever. Language, in short, as a great philologist has put it, "is not a test of race. It is a test of social contact." Waves of language have swept over Europe, leaving its racial foundations as undisturbed as are the

---

* Annales de Demographie, iv, p. 224; or more fully, with maps by the author, in Publications of the American Statistical Association, v, p. 28.

† The French and German portions of Switzerland are shown in Forschungen zur Deutschen Landes- und Volkskunde, viii, No. 5, 1894; and Rundschau für Geographie und Statistik, xiii, p. 337, appendix map.

‡ Map in Petermann's Geographische Mittheilungen, 1877, plate 17; *vide* also Globus, lxvi, p. 165; and Journal of the Anthropological Institute, ii, p. 108.

Revue de Geographie, xxxvii, p. 321. Perhaps the best compilation of references to ethnological maps extant, bringing them down to 1885, is given by Dr. Andrée in Mittheilungen des Vereins für Erdkunde zu Leipzig, 1885, pp. 173 *seq.*; less fully to 1879 in Archiv für Anthropologie, xi, p. 454. The editor confesses that nearly all of them are indeed not ethnological, but merely "speech" maps.

sands of the sea during a storm. The linguistic status of the British Isles, above described, shows us one of these waves—the Keltic—which is, to put it somewhat flippantly, now upon its last lap on the shores of the western ocean.

We may discover how slippery speech is upon men's tongues in yet another way—namely, by observing it actually on the move in a physically quiescent population, leaving a trail behind to mark its passage. Language becomes truly sedentary when a distinctive name is given by men to a place of settlement; it may be a clearing in the virgin wilderness or a renaming of a village after a clearing away by conquest of the former possessors. In either case the result is the same. The name, be it Slavic, Keltic, or other, tends to remain as a permanent witness that a people speaking such a tongue once passed that way. A place name of this kind may and often does outlive the spoken language in that locality. It remains as a monument to mark the former confines of the speech, since it can no more migrate than can the houses and barns within the town. Of course, newcomers may adapt the old name to the peculiar pronunciation of their own tongue, but the savor of antiquity gives it a persistent power which is very great. For this reason we find that after every migration of a spoken language there follows a trail of such place names to indicate a former condition. Our maps, both of the British Isles and of Spain, show this phenomenon very clearly. In the one case the Keltic speech has receded before the Teutonic influence, leaving a belt of its peculiar village names behind. In the other the Basque place names, far outside the present limits of the spoken Basque, indicate no less clearly that the speech is on the move toward the north, where no such intermediate zone exists.

Then, after the village names have been replaced by the newcomers, or else become so far mutilated as to lose their identity, there still linger the names of rivers, mountains, bays, headlands, and other natural features of the country. Hallowed by folklore or superstition, their outlandish sounds only serve the more to insure them against disturbance. All over England such names are not uncommon, pointing to a remote past when the Keltic speech was omnipresent. Nay, more, not only from all over the British Isles, but from a large area of the mainland of Europe as well, comes testimony of this kind to a former wide expansion of this Keltic language. Such geographical names represent the third and final stage of the erosion of language prior to its utter disappearance. Nevertheless, as we shall show, the physical features of men outlive even these, so inherent and deep rooted have they become. It is indeed true, as Rhys, himself a linguist, has aptly put it, that "skulls are harder than consonants, and races lurk behind when languages slip away."

It appears that language rests even more lightly upon men than do traditions and folk customs. We find that it disappears first, under pressure, leaving these others along with physical traits perhaps as sole survivors. There are several reasons for this mobility. One is that languages rarely coalesce.* They may borrow and mutilate, but they seldom mix if very distinct in type. The superior, or perhaps official, language simply crowds the other out by force. Organization in this case counts for more than numbers. In this way the language of the Isle de France has prevailed over the whole country despite its once limited area, because it had an aggressive dynasty behind it. Language, moreover, requires for its maintenance unanimous consent and not mere majority rule; for, so soon as the majority changes its speech, the minority must acquiesce. Not so with folk tales or fireside customs. People cling to these all the more pertinaciously as they become rare. And still less so with physical traits of race. Many of these last are not apparent to the eye. They are sometimes unsuspected until they have well-nigh disappeared. Men mingle their blood freely. They intermarry, and a mixed type results. Thus racially organization avails nothing against the force of numbers. In linguistic affairs nothing succeeds like success; but in anthropology impetus counts for nothing.

This does not mean that we are justified to measure race by the geographical distribution of arts or customs, for they also migrate in complete independence of physical traits. With the Keltic language spread the use of polished stone implements and possibly the custom of incineration, but this did not entail a new race of men. At times a change of culture appears, accompanied by a new physical type, as when bronze was introduced into Britain, or when the European races brought the use of iron to America. Of course, contact is always implied in such migration, although a few stragglers may readily have been the cause of the spread of the custom. This may not be true in respect to the migration of religions, or in any similar case where determined opposition has to be overcome and where conquest means substitution; but in simple arts of immediate obvious application, copying takes place naturally. The art spreads in direct proportion to its immediate value to the people concerned. No missionaries are needed to introduce firearms among the aborigines. The art speedily outruns race. Moreover, cultures like languages seldom mix as men do. Parts may be accepted here and there, but complete amalgamation seldom results. The main effect of

* *Vide* interesting discussion of this point in detail in A. H. Keane, Ethnology, pp. 198 *seq.*

the contact of two distinct cultures is to produce stratification. The common people become the conservators of the old; the upper classes hold to the new. It is a case of folklore and superstition *versus* progressive ideas. Here, as in respect of language, arts and customs become reliable as a test of race only when found fixed in the soil or in some other way prevented from migration.

Furthermore, let us not attach too much importance to the statements of historical and classical writers in their accounts of migrations and of conquests. We should beware of the travelers' tales of the ancients. Pliny describes a people of Africa with no heads and with eyes and mouth in the breast—a statement which to the anthropologist appears to be open to the suspicion of exaggeration. Even when conquest has undoubtedly taken place, it does not imply a change of physical type in the region affected. We are dealing with great masses of men near the soil to whom it matters little whether the emperor be Macedonian, Roman, or Turk. Till comparatively recent times the peasantry of Europe were as little affected by changes of dynasty as the Chinese people have been touched by the recent war in the East. To them personally, victory or defeat meant little except a change of tax-gatherers.

In this connection it should be borne in mind that conquest often affected but a small area of each country—namely, its richest and most populous portions. The foreigner seldom penetrated the outlying districts. He went, as did the Spaniards in South America, where gold was gathered in the great cities. France, as we know, was affected very unevenly by the Roman conquest. It was not the portion nearest to Rome, but the richest though remote one, which yielded to the Roman rule to the greatest extent. At all events, the Roman colonists in Gaul and Brittany have disappeared, to leave no trace. The Vandals in Africa have left no sign—neither hide nor hair, in a literal sense —nor is there evidence of the long English rule in Aquitaine. The Burgundian kingdom was changed merely in respect to its rulers; and spots in Italy like Benevento, ruled by the Lombards for five hundred years, are to-day precisely like all the region round about them.

The truth is that migrations or conquests to be physically effective must be domestic and not military. Colonization must take place by wholesale, and it must include men, women, and children. The Roman conquests seldom proceeded thus, in sharp contrast to the people of the East, who migrated in hordes, colonizing incidentally on the way. England was not affected by her Roman invasion, nor until the Teutons came by thousands. In anthropology as in jurisprudence, possession is nine points of

the law. Everything is on the side, physically speaking, of the native. He has been acclimated, developing peculiarities proper to his surroundings. He is free from the costly work of transporting helpless women and children. The immense majority of his fellows are like him in habits, tastes, and circumstances. The invader, if he remains at all, dilutes his blood by half as soon as he marries and settles, with the prospect that it will be quartered in the next generation. He can not exterminate the vanquished as savages do, even if he would. Nay, more, it is not to his advantage to do so, for labor is too valuable to sacrifice in that way. Self-interest triumphs over race hatred. He may kill off a score or two of the leading men and call it exterminating a tribe, as the great anthropologist Broca put it, but the probability is that all the women and most of the men remain. In the subsequent process of acclimatization, moreover, his ranks are decimated. He struggles against the combined distrust of most of his neighbors as well as with the migratory instinct which brought him there in the first place. If he excels in intelligence, he may continue to rule, but his line is doomed to extinction unless kept alive by constant re-enforcements. It has been well said that the greatest obstacle to the spread of man is man. One of the objects of our study will be to show, as Dr. Collignon affirms, that "when a race is well seated in a region, fixed to the soil by agriculture, acclimatized by natural selection, and sufficiently dense, it opposes an enormous resistance to absorption by newcomers, whoever they may be."

Population being thus persistent by reason of its indestructibility, a peculiar province of our study will be to show the relation which has arisen between the geography of a country and the character of its people. Historians have not failed in the past to point out the ways in which the migrations and conquests of nations have been determined by mountain chains and rivers. They have too often been content merely to show that the immediate direction of the movement has been dependent upon topographical features. We endeavor to go a step further in indicating the manner in which the ethnic character of the population has been determined by its environment, entirely apart from political or historical events as such, and as a result of social forces which are still at work. Thus we shall show that the physical character of the population often changes at the line which divides the hills from the plains. The national boundary may run along the crest of the mountain chain, while the ethnic lines skirt its base where the economic character of the country changes. In other cases, the racial may be equally far from the political boundary, since the river bed may delimit the state, while the racial divisions follow the watershed.

Modern political boundaries will, therefore, avail us but little; they are entirely a superficial product; for, as we insist, nationality bears no constant or necessary relation whatever to race. It is an artificial result of political causes to a great extent. From the moment an individual is born into the world, he finds himself exposed to a series of concentric influences which swing in upon him with overwhelming force. The ties of family lie nearest: the bonds and prejudices of caste follow close upon; then comes the circle of party affiliations and of religious denomination. Language encompasses all these about. The element of nationality lying outside of them all is as largely the result of historical and social causes as any of the others, with the sole exception of family perhaps. Race may conceivably cut across all these lines at right angles. It underlies them all. It is, so to speak, the raw material from which each of these social patterns is made up. It may become an agent to determine their intensity and motive, as the nature of the fiber determines the design woven in the stuff. It may proceed in utter independence. Race harmonizes, at all events, less with the bounds of nationality than with any other—certainly less so than with those either of social caste or religious affiliation. That nearly a half of France, while peopled by ardent patriots, is as purely Teutonic racially as the half of Germany itself is a sufficient example of the truth of our assertion. The best illustration of the greater force of religious prejudices to give rise to a distinct physical type is afforded by the Jews. Social ostracism, based upon differences of belief in great measure, has sufficed to keep them truer to a single racial standard, perhaps, than any other people of Europe. Another example of religious isolation, re-enforced by geographical seclusion, may be seen among the followers of the mediæval reformer, Juan Valdés. Persecuted for generations, driven high up into the Alps of northwestern Italy, these people show to-day a notable difference in physical type from all their neighbors.*

Political geography is, for all these reasons, entirely distinct from racial and social geography, as well in its principles as in its results. Many years ago a course was delivered before this Lowell Institute by M. Guyot, the great geographer, subsequently published under the caption The Earth and Man. It created a profound sensation at the time, as it pointed out the intimate relation which exists between geography and history; but it was of necessity extremely vague, and its results were in the main unsatisfactory. Its value lay mainly in its novel point of view. Since this time a completely new science dealing with man has arisen,

* Archivio per l'Antropologia, xx, pp. 61 *et seq.*; also R. Livi, Anthropometria militaire, p. 135.

capable of as great precision as any of the other natural sciences. It has humanized geography, so to speak, even as M. Guyot did in his time and generation; and it has enriched history and sociology in a new and unexpected way.

Historians have of late shown a distinct tendency toward a fuller appreciation of the importance of physical environment in human affairs.* The movement is probably at one with the newer conceptions of the pre-potency of social over political factors in the making of history. At all events, geography and history have been drawing nearer to one another under the distinguished leadership of the authors of The American Commonwealth, and of The Norman Conquest of England in the Old World. In America our own Justin Winsor has contributed manfully to the same end. We have now to bring still other elements —anthropology and sociology—into touch with these other two, to form a combination possessed of singular suggestiveness. It affords at once a means for the quantitative measurement of racial migrations and social movements; and it yields a living picture of the population—the raw material—in and through which all history must of necessity work. Studing men as merely physical types of the higher animals, we are able to trace their movements as we do those of the lower species; we may correlate these results with the physical geography and the economic character of the environment; and then, at last, superpose the social phenomena in their geographical distribution. We attempt to discover relations either of cause and effect, or at least of parallelism and similarity due to a common cause which lies back of them all—perhaps in human nature itself. Anthropology, geography, sociology, correlated and combined, such is the effect.

Our study thus overlaps several fields of investigation which have stood quite remote from one another in the past; yet it draws its material from each, and then returns it again endowed with a new and living significance. Some one has rightly said that many great advances in human knowledge have been due to those who effected new combinations of ideas by bringing together results from widely separated sciences. Helmholtz stands as a great modern example, physiologist, mathematician, natural philosopher. Goethe, Spencer, and many more could be cited as well in defense of the same proposition. Science advances by the revelation of new relationships between things. In the present case the hope of perhaps striking a spark, by knocking these divers sciences together, has induced men to collect materials, often in ignorance of the exact use to which they might be

* For a full discussion of this topic, reference may be made to a paper by the author in he Political Science Quarterly, vol. x, p. 636.

ultimately put. To show the results which have already been achieved is the task to which we have to address ourselves.

The observations upon which our conclusions for Europe are to rest, cover some ten or more million individuals, the larger fraction being school children, a goodly proportion, however, consisting of conscripts taken from the soil directly to the recruiting commissions of the various European armies. The labor involved in merely collecting, to say nothing of tabulating, this mass of material is almost superhuman; and we can not too highly praise the scientific zeal which has made possible our comfortable work of comparing this accumulated data. As an example of the difficulties which have been encountered, let me quote from a personal letter from Dr. Ammon, one of the pioneers in this work, who measured thousands of recruits in the Black Forest of Germany. "One naturally," he writes, "is reluctant to undertake a four or six weeks' trip with the commission in winter, with snow a metre deep, living in the meanest inns in the little hamlets, and moving about every two to five days. The official inspectors must not be retarded in their work, as the Ministry of War attaches that condition to their permission to view the recruits. Many of those rejected for service are dismissed by the surgeons at a glance, but I must make measurements on all alike. Only when the doctor stops to make an auscultation or to test the vision do I have a moment's respite. They are sent to my room from the medical inspector at the rate of two hundred in three hours, sometimes two hundred and forty; and on all these men I must make many measurements, while rendering instant decision upon the color of the hair and eyes. The mental effort involved in forming so many separate judgments in such quick succession often brings me near fainting at the close of the session."

Of course, where observations are privately made, to obtain the consent of the owner of the characteristics is the main obstacle to be overcome. To make the subject understand what is wanted is impossible, for it would involve a full discussion of the Keltic question or of the origin of the Aryans, which, after the first one hundred cases, becomes tiresome. The color of the hair and eyes, of course, may be noted in passing, and observers may station themselves on crowded thoroughfares and easily collect a large mass of material. I have myself found profit and entertainment on the Fall River boats in running up some columns from my unsuspecting fellow-passengers. But to make head measurements is another matter. Dr. Beddoe adopted an ingenious device which I will describe in his own words: "Whenever a likely little squad of natives was encountered the two archæologists got up a dispute about the relative size and shape of their own heads,

which I was called in to settle with the calipers. The unsuspecting Irishmen usually entered keenly into the debate, and before the little drama had been finished, were eagerly betting on the sizes of their own heads, and begging to have their wagers determined in the same manner."

The figures gathered in this way from the schools and the armies have a peculiar value. They represent all classes of the population, but more especially the peasantry in all the nooks and corners of Europe wherever the long arm of the *Polizei Staat* reaches. The upper classes are less fully represented oftentimes, since they attend private schools or are better able to evade the military service by money payment or by educational test. This simplifies the matter, since it is the *proletariat* which alone clearly reflects the influence of race or of environment. They are the ones we wish to study. In this sense the observations upon these populations may aid the sociologist or the historian; for the greatest obstacle, heretofore, to the prosecution of the half-written history of the common people has been the lack of proper raw materials. There is a mine of information here which has barely been opened to view on the surface.

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL.D., D.C.L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

VI.—THE SPHERE OF TAXATION PECULIAR TO THE FEDERAL GOVERNMENT OF THE UNITED STATES.

THE United States presents the curious anomaly of a great nation existing under two systems, or dual forms of government; each having a sphere of action peculiar to itself, and both exercising the general functions of government, namely: the executive, the legislative, and the judicial. These two are the Federal or national Government, existing in virtue of an agreement of union entered into originally by thirteen separate and independent States, and known as the Federal Constitution; and next, a system of State or divisional governments, existing in virtue of certain original powers retained by the independent and sovereign parties to the above agreement, and not delegated by them, in entering the Federal Union, to any other or higher sovereignty. At the same time a concession of power to tax or compel contributions from persons, property, and business by each of these two forms of government, in order to defray their necessary expenditures, was obviously essential to their existence and continuance, and was so recognized from the first inception

of any compact of union. But how to divide this power—the badge and symbol of sovereignty—between two distinct sovereignties of the same nation, namely, the Federal Congress and the Legislatures of the several States, and impose limitations in both cases on the exercise of a function so vast in its sweep and so imperative in its action, was one of the most difficult problems that confronted the framers of the Federal Constitution, and one without precedent in the world's history. The problem occasioned much discussion, and was really left unsettled—a general power being given to the national legislature, or Congress, "to lay and collect taxes, duties, imposts, and excises," with the limitation that "all duties, imposts, and excises shall be uniform throughout the United States"; that "no capitation or other direct tax shall be laid unless in proportion to the census"; that "no State shall, without the consent of Congress, lay any imposts or duties on imports or exports," and that no tax or duty shall under any circumstances be laid on articles *exported* from any State. Under such a loose and indefinite condition of things, a conflict of laws and of jurisdictions was inevitable, giving rise to controversies whose determination was really vital to the integrity and efficiency of the Federal Constitution. But happily, owing to the firmness and wisdom of the national tribunal (United States Supreme Court) before which these questions have been brought for adjudication, most of the difficulties which once seemed so formidable have been overcome, and are now mainly interesting as matters of history.

One of the earliest and most celebrated of these controversies culminated, as it were, in a case or suit known as McCulloch *vs.* Maryland, which came before the Supreme Court of the United States and was decided in 1819, under the following circumstances: Congress in 1815 chartered a national (United States) bank, which as a legitimate and authorized feature of its organization established branches in the States, with power to issue circulating notes. This measure proved unpopular in many of the States, and attempts were made by them to resist the various operations of this banking institution within their territory. Foremost among these was the State of Maryland, which, through an enactment of its Legislature, required every bank doing business in the State, and not chartered by the State, either to pay a stamp duty on every note issued, or pay a tax of $1,500 in gross per annum, and in addition imposed certain penalties on all the officers of a bank violating the law, and upon every person who had any agency in circulating such notes. Contemporaneously, also, the State of Ohio imposed an annual tax of $50,000 upon the branch bank of the United States established in that State.

The validity of the Maryland statute having been affirmed

by the Court of Appeals, the highest court of law in that State, and an action having been brought for the enforcement of a penalty against an official of the Maryland branch (United States) bank for a violation of the State law, the defendant—one McCulloch, the cashier of the said branch bank—thereupon brought the case (as involving an interpretation of the Federal Constitution) by writ of error before the United States Supreme Court.

A little reflection will abundantly satisfy the reader that the question involved in this procedure was of the greatest importance, inasmuch as it necessitated certain rational and fundamental conclusions that had not previously been authoritatively reached and popularly accepted, respecting the nature and power of the Federal Government; and a definite interpretation of the letter and spirit of certain features of the Federal Constitution which, as the action of the States before noticed demonstrated, had, to say the least, been heretofore regarded as ambiguous. So that, whatever might be the decision of the court, the consequences were certain to be most momentous. Thus, if the right of a State to tax—which practically involved the right to destroy the instrumentalities of the Federal Government, was denied, then such Government rested on sure foundations. If, on the other hand, to quote the language of the court, "the right of the State to tax the means employed by the General Government be conceded, the declaration that the Constitution and laws made in pursuance thereof shall be the supreme law of the land is an empty and unmeaning declaration," and the United States, in the sense of a nation, would practically cease to exist. Taking also into account the increase in the number of States that would have to harmonize if anything was accomplished in a new constitutional convention, and the number of new antagonizing elements on the part of the several States that had arisen—the vexing question of the future tolerance and extension of slavery, which finally eventuated in civil war, the power of Congress to create banking corporations, and the right of the Legislatures of the States to subject them to taxation, and the like—and it is very doubtful whether any new Federal Constitution could have been established. As a matter of fact, the Federal Government and the union of the States came nearer disruption and dissolution in 1819 than when, forty-two years subsequently, Fort Sumter was fired upon and the flag of the Union forcibly hauled down—which latter events are generally regarded as constituting the leading features of the constitutional history of the United States. And this situation was so well recognized by Chief-Justice Marshall (to whom the nation is indebted for its preservation to a greater degree than has been generally recognized) as to draw from him

the remark, preliminary to announcing the decision of the court, that "no tribunal could approach such a question as was involved without a deep sense of its importance and of the awful responsibility involved in the decision."*

The decision of the court was unanimous that "the States have no power, by taxation or otherwise, to retard, impede, burden, or in any manner control the operation of the constitutional laws enacted by Congress to carry into execution the powers vested in the General Government; and that the law passed by the Legislature of Maryland imposing a tax on the Bank of the United States is unconstitutional and void."

"If we apply," said the Chief Justice, "the principle for which the State of Maryland contends to the Constitution generally, we shall find it capable of changing totally the character of that instrument. We shall find it capable of arresting all the measures of the Government, and of prostrating it at the foot of the States. The American people have declared their Constitution and the laws made in pursuance thereof to be supreme; but this principle would transfer the supremacy, in fact, to the States. If the States may tax one instrument employed by the Government in the execution of its powers, they may tax any and every other instrument. They may tax the mail; they may tax patent rights; they may tax the papers of the custom house; they may tax judicial process; they may tax all the means employed by the Government, to an excess which would defeat all the ends of government. This was not intended by the American people. They did not design to make their Government dependent on the States."

The court, however, held that its decision did not deprive "the States of any resources which they originally possessed. It does not extend to a tax paid by the real property of the bank, in common with the other real property within the State, nor to a tax imposed on the interest which the citizens of Maryland may hold in this institution, in common with other property of the same description throughout the State. But this is a tax on the operation of the bank, and is consequently a tax on the operation of an instrument employed by the Government of the Union to carry its powers into execution. Such a tax must be unconstitutional."†

---

* "No more impressive words are to be found in any English or American adjudication than those uttered by Chief-Justice Marshall as a preamble to the judgment in this most interesting and important case."—*Francis Hillard, The Law of Taxation.*

† The following additional extracts from the decision of the court in this celebrated case will help to a further elucidation of its involved subject-matters:

"In the case now to be determined," said the Chief Justice, "the defendant, a sovereign State, denies the obligation of a law enacted by the Legislature of the Union; and the plaintiff, on his part, contests the validity of an act which has been passed by the Legislature of that State. The Constitution of our country, in its most interesting and vital

The successful counsel in this case were Daniel Webster and William Pinkney, and in the course of his decision the Chief Justice complimented the counsel on both sides as maintaining the affirmative and negative with a splendor of eloquence and a strength of argument seldom, if ever, surpassed.

It may also be added that no decision of the United States Supreme Court, or of any other court in the United States, has since impugned the correctness of the principle upon which the case of McCulloch *vs.* Maryland was decided. A brief notice, however, of subsequent judicial proceedings is interesting and necessary to complete the history of this celebrated case.

Thus, the Legislature of Ohio having, as before stated, imposed an annual tax of $50,000 upon the branch of the Bank of the United States established in that State *before* the decision in the McCulloch case, the State officers, even *after* the decision, proceeded to levy and collect the tax. Thereupon the case was again brought before the United States Supreme Court on an application for injunction, and was reargued, with reliance upon the point that the bank was a mere private corporation, whose chief object was individual trade or profit. The court, however, at once reaffirmed its former judgment, and held that the bank was a public corporation, created for national purposes, and an instrument for carrying into effect the national powers. At the same time the opinion of the court in the McCulloch case, that its decision "did not deprive a State of any resources it originally possessed," remained unaffected.

Subsequently a case came before the United States Supreme Court (Weston *vs.* the City of Charleston, S. C.) in which the question involved was the right of a State to tax stock issued for loans made to the United States, whether on the stock, *eo nomine* or included in the aggregate of the tax-payers' property to be valued, at what it was worth. The court, by Chief-Justice Mar-

---

parts, is to be considered; the conflicting powers of the Government of the Union and of its members are to be discussed; and an opinion given which may essentially influence the great operations of the Government. No tribunal can approach such a question without a deep sense of its importance and of the awful responsibility involved in its decision. But it must be decided peacefully, or remain a source of hostile legislation; perhaps of hostility of a still more serious nature; and if it is to be so decided, by this tribunal alone can the decision be made. On the Supreme Court of the United States has the Constitution of our country devolved this important duty. The sovereignty of a State extends to everything which exists by its own authority, or is introduced by its permission; but it does not extend to those means which are employed by Congress to carry into execution powers conferred on that body by the people of the United States. We think it demonstrable that it does not. These powers are not given by the people of a single State. They are given by the people of the United States to a Government whose laws, made in pursuance of the Constitution, are declared to be supreme. Consequently, the people of a single State can not confer a sovereignty which will extend over them."

shall, held "*that a tax on stock of the United States, held by an individual citizen of a State, is a tax on the power to borrow money on the credit of the United States, and can not be levied on the authority of a State consistently with the Constitution,*" and, further, "*that if the right to impose a tax exists, it is a right which, in its nature, acknowledges no limits. It may be carried to any extent within the jurisdiction of the State or corporation which imposes it, which the will of such State or corporation may prescribe.* Can anything," continued the Chief Justice, "be more dangerous or more injurious than the admission of a principle which authorizes every State and every corporation in the Union which possesses the right of taxation to burden the exercise of this (borrowing) power at their discretion?" A tax on the stock or bonds of a State is therefore a tax on the borrowing power of such State.

The court further held that a tax of this description was a tax upon contracts,* using the following language: "Congress has power to borrow money on the credit of the United States. The stock it issues is evidence of a debt created by the exercise of this power. *The tax in question is a tax upon the contract subsisting between the Government and the individual.* It bears directly upon the contract. While subsisting and in full force, the power operates upon the contract the instant it is framed, and must imply a right to affect that contract. If the States and corporations throughout the Union possess the power to tax a contract for the loan of money, what shall arrest the principle in its application to every other contract? What measure can Government adopt which will not be exposed to its influence? The right to tax the contract to any extent, when made, must operate upon the power to borrow before it is exercised, and have a sensible influence

* What interpretation the Supreme Court puts upon the word "*contract*," as found in that clause of the Constitution of the United States which provides "that no State shall pass any law impairing the obligations of contracts," is made clear by the following language employed by Chief-Justice Marshall in giving the opinion of the court in the celebrated case of the Trustees of Dartmouth College *vs.* Woodward: "The term contract must be understood as intended to guard against a power of at least doubtful utility, the abuse of which had been extensively felt, and to restrain the Legislature in future from violating the right to property; that anterior to the formation of the Constitution a course of legislation had prevailed in many if not all of the States which weakened the confidence of man in man, and embarrassed all transactions between individuals, by dispensing with a faithful performance of engagements. To correct this mischief by restraining the power which produced it, the State Legislatures were forbidden 'to pass any law impairing the obligations of contracts'—that is, of contracts respecting property, under which some individual could claim a right to something beneficial to himself; and that, since the clause in the Constitution must in construction receive some limitation, it may be confined, and ought to be confined, to cases of this description—to cases within the mischief it was intended to remedy."

on the contract. The extent of this influence depends on the will of a distinct government. To any extent, however inconsiderable, it is a burden on the operations of government. It may be carried to an extent which shall arrest them entirely."

As a sequence to these decisions of the United States Supreme Court, not only has the general principle that no State of the Federal Union can impose any tax upon any agency of the Federal Government—as its mails, its buildings, its lands, its ships, its money, and the like—come to be universally recognized as in the nature of an unquestionable law of the land, but the question of the application of the principle in respect to many cases to which some latitude of opinion was legitimate, has been specially and definitely determined. Thus, for example, it has been established, that a State can not impose license taxes upon persons passing through or coming into it merely for a temporary purpose, especially if connected with interstate commerce; a State, furthermore, can not enact any law or establish any regulation affecting interstate commerce, inasmuch as the same would be an unauthorized interference with the power given to Congress on the subject. Interstate commerce also can not be taxed at all by a State statute, even though the same amount of tax should be laid on commerce which is carried on solely within the State; and the negotiation of sales of goods, which are in another State, for the purpose of introducing them into the State into which said negotiation is made, has been held to be interstate commerce. A tax levied by the State of Michigan of one cent and a half a ton on iron ores, if taken out of the State for smelting, while exempt if smelted within the State, was held by the United States Supreme Court to be a tax on commerce and therefore void.

A State statute which levies a tax upon the gross receipts of railroads for the carriage of freights and passengers into, out of, or through a State has been held to be a tax upon commerce between the States, and therefore void. Under the provision of the Federal Constitution that "no State shall, without the consent of Congress, lay any imposts or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws," some difficulty has been experienced in indicating with sufficient accuracy for practical purposes, the point of time at which articles brought into the country from abroad cease to be regarded as imports in the sense of constitutional protection, and become liable to State taxation. But it has been held by the United States Supreme Court that where the importer has so acted upon the thing imported that it has become incorporated and mixed up with the mass of property in the country, it has lost its distinctive character as an import, and become subject to

the taxing power of the State; but while remaining the property of the importer, in his warehouse, in the original form or package in which it was imported, a tax upon it is too plainly a duty upon imports to escape the prohibition in the Constitution. The deductions from a contrary rule would be manifestly as follows: "No goods would be imported if none could be sold. The same power that imposes a light duty can impose one that amounts to prohibition. A duty on imports is a tax on the article, which is paid by the consumer. The great importing States would thus levy a tax on the nonimporting States," as was done under articles of the Confederation prior to the adoption of the Federal Constitution. "This would necessarily produce countervailing measures."

In the case of Brown *vs.* Maryland, where the latter State, for revenue purposes, required a merchant to take a license and pay fifty dollars before he should be allowed to sell a package of imported goods, the court (by Chief-Justice Marshall) held that this tax, *though indirect in form* (i. e., a license on the person of the importer), was in fact equivalent to a duty on imports, and therefore illegal; and that the right to import carried with it the right to sell.*

This decision has been carefully recognized by the authorities of the several States in dealing with imported liquors under local license acts. "Under its police powers there is no constitutional restraint on a State prohibiting the retail and internal traffic in ardent spirits. But a State is at the same time bound to receive and permit the sale by the importer of any article of merchandise which Congress authorizes to be imported, but it is not bound to abstain from the passage of laws which it deems proper to guard the health or morals of its citizens, although the effect of such laws may be to discourage importation, and diminish the profits of the importer and the revenue of the General Government."—*Burroughs, On Taxation.*

LIMITATIONS OF THE TAXING POWER OF THE FEDERAL GOVERNMENT.—If the States can not tax the agencies or instrumen-

* As an extension of the history of this case the following futile criticism of a former chairman of the Board of Assessors of the City of Boston (report for 1871) is pertinent: "There is certainly a broad distinction between the prohibition of the right to *sell* an imported article and the right to *tax* the same as property. The decision of the United States Court was to the effect that the State could not enact a law that would prevent the sale of such property, and did not touch the question of the right to tax. In a recent decision of the Supreme Judicial Court of Massachusetts (Dunbar *vs.* Boston, 101 Mass., 317), where the question was raised that the Commonwealth could not tax a stock of liquors, the sale of which, by her laws, she had declared illegal, the court sustained the tax, upon the ground that the case did not show that the goods could not be legally sold. As the law stood at the time the decision was given, but one class of the plaintiff's stock of intoxicating liquors could legally be sold; and that was his *importations in the original packages.*"

talities by which the Federal Government performs its functions, it would seem clearly to follow that for like reasons the Federal Government can not tax State instrumentalities or agencies.

That such reciprocal limitations are natural and necessary, and exist by implication, not only in the Constitution of the United States, but also in the very structure of the Federal Union, must be evident, when one reflects that otherwise the Federal Government on the one hand, and the governments of the States on the other, might impose taxation to an extent that would cripple, if not wholly defeat, the operations of the two authorities, each within its respective and proper sphere of action. Or, in other words, if the Federal and the State governments had each unrestricted power to tax, or, what is equivalent, "the power to destroy," they might, and as experience proves they probably would, effectually destroy efficient government in both cases, and the necessity and validity of such reciprocal limitations have been recognized and enforced by the courts of the United States whenever this question has been brought before them for adjudication. Thus, in the case of Day *vs.* Buffington, United States Circuit Court, Massachusetts District, it was held that the salary of a State official, in this particular instance a judge of probate, could not be legally subjected to assessment for an income tax, under the laws of the United States authorizing the assessment and collection of internal revenue; and Congress, some years since, acting under the advice of the United States Supreme Court, repealed so much of an internal revenue act as previously required the affixing of stamps to State processes, warrants, commissions, etc. In the case of Warren *vs.* Paul, 22 Ind., 279, the court used the following language: "The Federal Government may tax the Governor of a State or the clerk of a State court and his transactions as an individual, but not as a State officer. This must be so, or the State may be annihilated at the pleasure of the Federal Government. The Federal Government may, perhaps, take by taxation most of the property in a State if exigencies require, but it has not a right by direct or indirect means to annihilate the functions of the State government."

In a recent debate in the United States Senate on a proposition to appropriate public money for the purpose of establishing and maintaining higher institutions of learning in the District of Columbia than were offered by its common schools, a leading Senator (John Sherman), others concurring, is reported as expressing himself as follows:

"I concur entirely in the opinion expressed by the Senator from Rhode Island (Mr. Aldrich) that we have no right to use the public money to establish business high schools. It is the duty of every community to give the children who are growing up a

good common-school education, which covers a pretty wide range now, according to the general ideas of our people, and there the duty should stop. Money for this purpose should be contributed by private persons. We do our duty when we furnish a fair, common-school education to the children that are growing up among us"—i. e., in the District of Columbia—"and that is all we ought to contribute."

CAN CONGRESS AUTHORIZE THE STATES TO TAX NATIONAL INSTRUMENTALITIES?—In the popular discussions which have occurred in recent years in reference to the taxing of United States securities, the position has been not infrequently taken that it would have been just and expedient on the part of Congress, at the time of the creation of the present national debt, to have allowed the separate States to tax the evidences of such debt (i. e., the bonds) in the possession of their citizens, subject to a limitation that the same should not be taxed at any different rate than other "moneyed capital." A full consideration of the whole subject will, however, suggest a doubt whether Congress possesses the power to grant any such authorization, inasmuch as to have done so would have been equivalent to authorizing the States to do an act which in itself is unconstitutional—a thing which it is self-evident that Congress can not do. Thus "*the power to tax*," says Chief-Justice Marshall, in giving the opinion of the Supreme Court denying the right of Maryland to tax the Bank of the United States, "*involves the power to destroy*"; and in the case of Weston *vs.* The City of Charleston, the same court, by the same eminent authority, held further, as before shown, "*that if the right to impose a tax exists, it is a right which in its nature acknowledges no limits.*" For Congress, therefore, to have authorized the States to tax "national agencies" would have been equivalent to authorizing the exercise of a right to destroy; which right, the Supreme Court has held, can not, from its nature, when once existing, be limited.

ALIENATION OF THE TAXING POWER.—The application of the decision by the United States Supreme Court in the celebrated Dartmouth College case, has resulted in the general acceptance of the legal principle that a charter of incorporation by a State is a contract between the State and the incorporators; and if such charter contains a clause exempting the incorporators entirely from taxation, or for a definite period, a subsequent Legislature can not repeal the clause of exemption. Within a recent period the interest involved in this question has become so great, and the power of wealthy corporations who claim the benefit of this principle is so extensive, that it is desirable to briefly call attention to views of dissenting legal authorities and dissenting State courts.

"It is claimed that the power of taxation is one of the sovereign powers of the State necessary to its continued existence, and that it was never contemplated, when the people through their Constitutions delegated to their representatives in Legislature assembled the power to make laws for the good of the people of the State, that this grant of legislative power carried with it the right to barter away with private corporations one of the essential prerogatives of the Government, the very life-blood of the State." *

How one of the States of the Union—Connecticut—has recently thrown away valuable public franchises is thus graphically described by one of the leading and authoritative newspapers of New England—i. e., the Springfield Republican. We have here the astonishing fact that over seventy per cent of the stock capital of twenty-six monopoly electric or "trolley" companies operated in that State has been issued for something other than money, (cash) paid in, and hence may be said to represent nothing but what is popularly characterized as "water." The bonded debt of these roads amounts to $8,690,100, or over three times the amount of their cash stock—i. e., $2,671,240. This bonded debt, standing in comparison with a total stock issue, strikingly illustrates what has taken place: *first*, a gratuitous grant or franchise; *second*, an issue of bonds thereon to build the roads; *third*, a share capital, the product of the printing press, and representing no value whatever except as an instrumentality for obtaining extra profits and exceptional legislation through its distribution.

"This watered capitalization will in time, of course, pass into innocent hands, and the 'rights' of the monopolies in the matter of charges will all be gauged by the yearly revenue in its relation to this totality of nominal capital. The stock waterers will have sold their water at handsome figures and made off, and the purchasers of the water must henceforward, of course, be considered legitimate investors whose holdings are entitled to full consideration; and only until monopoly charges suffice to pay eight and ten per cent on all capital, watered or otherwise, will it be safe for any community to demand a reduction of charges without bringing upon itself the charge of being favorable to anarchy and confiscation.

"The people of Connecticut are preparing the way to pay handsomely for their electric transportation. The penalty of present neglect to guard and restrict closely the capitalization of these monopolies will fall in ugly force upon this and future generations; and when the time is ripe for municipal or State assumption of the monopolies, as may some time happen, the people

* Burroughs On Taxation, from which authority the writer is mainly indebted in his presentation of this important subject.

will have the pleasure, no doubt, of paying more than face value for the water now so freely allowed to issue."

On this subject the late Chief-Justice Taney expressed his views as follows, in a case that came up before the United States Supreme Court in 1853: "The powers of sovereignty confided to the legislative body of a State are undoubtedly a trust committed to them to be executed to the best of their judgment for the public good; and no one Legislature can by its own act disarm its successors of any of its powers or rights of sovereignty confided by the people to the legislative body, unless they are authorized to do so by the Constitution under which they are elected. They can not, therefore, by contract, deprive a future Legislature of the power of imposing any tax it may deem necessary for the public service, or of exercising any other act of sovereignty confided to the legislative body, unless the power to make such contract is conferred upon them by the Constitution of the State. And in every controversy on this subject the question must depend on the Constitution of the State, and the extent of the power thereby conferred on the legislative body."

The subject again came up before the United States Supreme Court in 1869, 1871, and 1872, when the question at each time was treated as *res adjudicata* (definitely settled). In the first of these instances Justice Miller thus expressed his views: "We do not believe that any legislative body, sitting under a State Constitution of the usual character, has a right to sell, to give, or bargain away forever the taxing power of the State. This is a power which, in modern political societies, is absolutely necessary to the continued existence of every such society. While under such forms of government the ancient chiefs or heads of the Government might carry it on by revenues owned by them personally and by the exaction of personal service from their subjects, no civilized Government has ever existed that did not rely upon taxation in some form for the continuance of that existence. To hold, then, that any one of the annual Legislatures can, by contract, deprive the State forever of the power of taxation is to hold that they can destroy the Government they are appointed to serve, and that their action in that regard is strictly lawful. The result of such a principle, under the growing tendency to special and partial legislation, would be to exempt the rich from taxation and cast all the burden of the support of government on those who are too poor or too honest to purchase such immunity."

Like dissenting views have also found expression in various State courts. Chief-Justice Beasley, of New Jersey, for example, in commenting on the proposition that a charter of incorporation is a contract, says: "The entire contract on the part of a State, implied in such cases, is the supposed legislative agreement not

to alter or recall the privilege granted. No other stipulation on the part of the State was ever suggested to exist, and it was the imagined existence of such stipulation alone which converted what else, in all its essential qualities as well as in its form, was an act of legislation, into a contract on the part of the community with the corporators. Without such stipulation, having an obligatory force, I am wholly unable to conceive the ground of difference between the charter of a corporation and any other act of legislation. If a statute lay no obligation on the State to do or refrain from doing a particular thing or one or more particular things, such an enactment seems to me to be a pure act of legislation, and in no sense a contract." "A law which seeks to deprive the Legislature of the power to tax must be so clear, explicit, and determinative that there can be neither doubt nor controversy about its terms, or the consideration which rendes it binding. Every presumption will be made against its surrender, as the power was committed by the people to the Government to be exercised, and not to be alienated." (47 Missouri, 158.)

And Justice Cooley (one of the justices of the Supreme Court of Michigan), in reviewing the action of the United States Supreme Court, says: "It is not very clear that this court has ever at any time expressly declared the right of a State to grant away the sovereign power of taxation." A court in Pennsylvania has also said: "Revenue is as essential to government as food to individuals; to sell it is to commit suicide." (30 Pennsylvania Statutes, 9.)

Turning to English jurisprudence, we have an opinion of Edmund Burke that the charter of the East India Company, in virtue of which great authority was exercised, "was a charter to establish monopoly and create power," and not entitled to the protection of the various charters of English liberty.

So long, however, as the decision of the United States Supreme Court in the Dartmouth College case is not reversed by the same court, the above and many other like expressions of opinion on the part of judges and men learned in the law and in constitutional history have nothing of practical significance.

THE study of the customs and religious views of the Kekchi Indians of Guatemala, by Dr. C. Sapper, has uncovered a curious mixture of pagan and Christian ideas. The people are nominally attached to the Roman Catholic Church, yet they will not worship in a church out of their own district because they believe the god of that church can not understand them. So, when they go away from home, they give up all religious exercises. On first crossing a mountain pass the Indians put a stone at the foot of the cross which is usually erected there, often offering flowers and incense, and sometimes dancing before it besides; but if there be no cross at the pass, the Kekchi Indian prays and brings offerings to the heathen god.

INDIAN WAMPUM RECORDS.

By HORATIO HALE.

IT is a notable fact that the Indian tribes of northeastern America, belonging to the Iroquoian and Algonquian families, who at the first coming of the white colonists occupied the eastern portions of what are now the United States and Canada, and who are often styled savages, had two inventions or usages which are ordinarily deemed the special concomitants of an advanced civilization. These were a monetary currency and the use of a form of script for conveying intelligence and recording facts. These customs or inventions were connected with one medium, but it is probable that the inventions themselves belong to widely different periods.

In a paper which was read before the British Association for the Advancement of Science at Montreal in August, 1884, and was published in the Popular Science Monthly for January, 1886, I produced the evidence which seemed to me to show that the shell money of North America was derived from the ancient tortoise-shell money of China. This shell money preceded the metallic coins, commonly known as *cash*, which are circular disks of copper perforated in the center, and usually strung on a string. These came into use more than two thousand years before the Christian era. The shell money which preceded the copper *cash* has been traced eastwardly, through the Pelew Islands and the Micronesian groups of the North Pacific, to the coasts of California and Oregon, where it is in use among the Indians to this day, and whence it has apparently made its way across the continent to the eastern coast. As was then remarked, "The fact that the Indians of the west coast of America received their monetary system from eastern Asia or from the Pacific islands could not in itself be regarded as affording evidence that America was first peopled from that direction, just as the fact that the coinage of Bactria was derived from Greece would not indicate that the Bactrian population was of Grecian origin. All that we could infer would be some early intercourse, such as recent experience warrants us in supposing. A Chinese junk or a large Micronesian *prao*, drifting to the Californian coast some three or four thousand years ago, would sufficiently explain the introduction of an art so easily learned as that of making and using perforated shell disks for money."

There is good evidence, from the disclosures of the ancient mounds, to show that shell beads were largely used by the Indians of former ages as ornaments, and perhaps as valued treasures. But there seems no clear proof that they were employed for mne-

monic purposes until a comparatively recent date. My late distinguished friend Sir Daniel Wilson had indeed inferred this use of them in former times. In his Prehistoric Man (page 77 of the third edition) he tells us that "in the Grave Creek Mound, shell beads, such as constitute the wampum of forest tribes, amounted to between three and four thousand; and it seems singularly consistent with the partial civilization of the ancient mound builders to assume that in such deposits we have the relics of sepulchral records which constituted the scroll of fame of the illustrious dead, or copies of the national archives deposited with the great sachem to whose wisdom or prowess the safety of his people had been due." This inference seemed to me natural and reasonable; but more recent studies have induced me to question it. Many fragments of ancient cloth have been found in the mounds. The wampum belt was a woven structure of peculiar firmness, having a strong warp, with a duplicate woof, on which the beads were strongly attached. That no fragment of such a record has been found in our ancient mounds is surprising, if such numbers of them were buried as this presumption would lead us to suppose. Moreover, it is doubtful if the true wampum bead of the modern belt was in general use in prehistoric times. The shell beads of those times, if small, are of oval or ovoid shape, and, if large, are thick circular disks, resembling modern button molds, or still larger. The beads in modern belts are, as is well known, oblong tubes, about the fourth of an inch in length, shaped like pieces of a tobacco pipe cut off square at the ends. They are well suited to be woven together in a belt, but are otherwise not adapted either for ornament or for use as money. Mr. Holmes, in his valuable paper on Art in Shell of the Ancient Americans, published in the Second Annual Report of the Bureau of Ethnology, remarks that "it is not known positively that beads of this particular shape were employed in pre-Columbian times; but it is certainly one of the earliest historical forms, and one which has been manufactured extensively by the Indians as well as by the whites. They may be found both in very old and in very recent graves, and have always formed an important part of the stock of the Indian trader."

The conclusion to which I have been led by these and other evidences is that the use of wampum for conveying messages and preserving records was one of the improvements which accompanied the formation of the Iroquois confederation, and was most probably due to the genius of Hiawatha. Like all his other reforms, it merely brought into clear and useful shape a tendency toward which his people had been advancing. We can not doubt that in dealings between different native tribes there would have been frequent interchange of presents; and no presents would be

more likely or more acceptable than strings of the valued wampum. To weave a number of these strings together in a belt, inscribed with a mark indicative of its purpose, would be a natural idea. But the custom resulting from this idea had in it, as Mr. Holmes well observes, "a germ of great promise, one which must in time have become a powerful agent in the evolution of art and learning. It was a nucleus about which all the elements of culture could arrange themselves." Unfortunately, the advent of the white settlers, bringing with them the seeds of inevitable war and disease, blighted these prospects. It is interesting to consider what might have been the fruits of the principles of peace and progress planted by the Iroquois reformer and his coadjutors if time had been allowed for their display. There is no good reason for doubting that the figures on the wampum records, which had already, when the whites arrived, passed beyond the stage of mere picture writing, might have developed into a phonetic system, as we know had been the case with the Mexican script at the time of the conquest; and we have reason to believe that the Mayan script was undergoing the same evolution. The Mexican civilization, such as it was, had shocking features, which do not allow us to regret its destruction. The Mayan, however, was much less offensive; and as for the Kechuas, or Peruvians, the striking facts set forth by Sir Clement Markham in his recent history of Peru, showing that the oppressive exactions of the Spanish conquerors had in a little over three centuries reduced the native population from eleven millions to less than one million, would seem to establish the truth of the assertion which has been made by Carli, Draper, and other writers, that the Spanish conquest destroyed a superior civilization, to replace it by a form decidedly inferior.

It is a well-known fact that the tradition of the Iroquois people ascribes the invention, not of wampum itself, but of the wampum "belt" or record, to Hiawatha. His name, *Hayuñwatha*, means "The Maker of the Wampum Belt," being derived from *ayuñwa* (wampum belt) and an old verb, *katha*—now, according to Father Cuoq, rarely used—signifying "to make." When I first heard the tradition—being then of opinion that the wampum belt was an ancient Indian construction, dating back to the times of the mound builders—I formed and expressed the conclusion that the tradition had, like many such legends, grown out of the name. Later inquiries, however, have led me to believe that this conclusion was too hastily formed, and that the name, which may be briefly rendered "the wampum-belt maker," was one of those titles which were not infrequently given by the Iroquois to a member of the tribe to commemorate some notable achievement which he had effected. Its date would then, as has

been said, be that of the formation of the Iroquois confederacy. This date was fixed by the estimates severally made at different times by my friend the Hon. L. H. Morgan and myself, in accordance with the testimony of the leading Iroquois chiefs, at about the middle of the fifteenth century, or, more precisely, about the year 1459. Other investigators, whose views are entitled to respectful consideration, including the Rev. Dr. Beauchamp and Mr. J. N. B. Hewitt, have been inclined to place the formation of the league at a later time. But their conclusions differ considerably, and fail to account for many important facts. I am therefore compelled to adhere to my original estimate. I fully accept Mr. Hewitt's identification of the "Trudamani" or "Toudamani," of whom Jacques Cartier heard from the Hurons in 1535, with the well-known "Tsonnontowanen" of later writers. These "great mountain people," or Senecas, were the most powerful of the Iroquois nations, and their name was commonly used by the Hurons or Wyandots from ancient times as the general name of all the Iroquois confederates. This we learn from the little book entitled Origin and Traditional History of the Wyandots, published at Toronto in 1870 by Peter Dooyentate Clarke, a half-breed Wyandot, and giving much important information concerning the traditions of his people. He speaks particularly of the war which occurred "in the first quarter of the sixteenth century," between the Hurons and the Senecas (or Iroquois), who had previously lived on friendly terms, though in separate villages, on the St. Lawrence River, near what is now Montreal, but was then the site of the Huron capital town of Hochelaga. The result was that the Hurons, later in the same century, broke up their villages near Montreal, and journeyed westward, and afterward northward, until they reached Lake Huron. Meanwhile the warfare between the two leading branches of the Huron-Iroquois stock continued through the sixteenth and seventeenth centuries. All this is simply historical, and accords in the main with the narratives of the French explorers, from Cartier to Champlain and Charlevoix, and with the traditions of both branches of the Huron-Iroquois family.

Between the year 1459 and that of Cartier's arrival at Hochelaga, in 1535, there was ample time for the Hurons to become familiar with the new art of making wampum belts. In fact, we learn from Cartier's narrative that they were then proficient in it. When he kidnapped Donnaconna, the chief of Stadaconé (now Quebec), to carry him to France, the terrified people, in the hope of redeeming him, presented to the captain no less than twenty-four "collars of porcelain," or wampum belts, which, the writer tells us, "is the greatest treasure they have in the world, for they prize it above gold and silver."

Another inquiry of interest relates to the time when wampum ceased to be made by the Indians. That the records are retained to this day among certain tribes is well known, though their use is slowly dying out. But the beads themselves are no longer made by the Indians. As regards the time when their manufacture ceased, very vague and some very erroneous ideas have prevailed. It is well known that for more than a century—in fact, for the greater part of two centuries—the wampum beads have been made by the whites for use in commerce with the Indians; and an opinion has grown up that this has been the case ever since the first arrival of the white colonists, and that most of the wampum records held by the Indian tribes have been woven from these modern machine-made beads. Mr. Holmes, however, gives the historical evidence which shows that this opinion has originated in error. He quotes Thomas Morton, of Massachusetts, who in 1630, writing of the New England Indians, tells us that "they have a kind of beads instead of money, to buy withal such things as they do want, which they call *wampumpeak*; and it is of two sorts; the one is white and the other is a violet color. These are made with the shells of fish. The white with them is as silver is with us, the other as our gold; and for these they buy and sell, not only among themselves, but even with us. These beads are current in all parts of New England, from one end of the coast to the other; and although some have endeavored by example to have the like made of the same kind of shells, yet none has ever as yet attained to any perfection in the composure of them, but the salvages have found a great difference to be in the one and the other, and have known the counterfeit beads from those of their own making, and do slight them." Nearly a century later the Carolina surveyor, Lawson, writing in 1714 of the same money, speaks of it as "all made of shells which are found on the coast of Carolina, which are very large and hard, so that they are very difficult to cut. Some English smiths," he adds, "have tried to drill this sort of shell money, and thereby thought to get an advantage, but it proved so hard that nothing could be gained." The introduction of the machine drill could not, in fact, have made much difference in this respect, as each bead must still be fashioned separately by a white workman, whose time was much more valuable than that of an Indian. That which finally gave the English beads an advantage was not the superiority or the cheapness of their workmanship, but the destruction of the Indian workmen. The quarter of a century which followed the publication of Lawson's book, from 1714 to 1740, saw the extermination of most of the Carolina tribes, and a great decline in the numbers of the Northern Indians from the effects of war and pestilence. It was during this period that the wampum-making industry seems

to have ceased among them, and the use of machine-made beads to have become universal. The wampum belts continued for a century longer to be made from these beads by the Indian women, but the difference between the belts of the two periods is apparent at a glance. The hand-made beads in the earlier belts are of various sizes, some being twice as large as others, while the machine-made beads, of which the more recent belts are composed, are all of uniform size. Such belts can still be procured from the civilized and mostly half-breed Iroquois of the province of Quebec, with any devices that may be desired. They differ from the genuine Indian belts precisely as a counterfeit *denarius* differs from a genuine Roman coin.

SOME PRIMITIVE CALIFORNIANS.

By MARY SHELDON BARNES.

IN the Santa Clara Valley, near the southern end of San Francisco Bay, some five miles south of Stanford University, there stands a fine old deserted abode, formerly a well-known station on the road from the Santa Clara Mission to San Francisco. Its owner, Don Secundini Robles, was of the pure old Castilian stock, and he and his wife, Donna Maria, were lord and lady for all the region round, and their house the center for all the gay *rodeos* and *fandangos* of the valley. Now the house is a ruin, Don Secundini dead, and Donna Maria, in poverty and alone, lives in the village of Mountain View. But their name passes on to fame among the Stanford students in connection with the Robles Rancheria, a large, low-lying mound of earth some quarter of a mile away from the old house, with that mysterious reputation attaching to it that always hovers around an Indian mound. It has indeed an artificial look, rising in the midst of the otherwise level valley; and the boys of the vicinity assured us that there were plenty of skeletons in it. The man who owned it said that when he first began to plow in that field he turned up human bones, and added, "You may guess I was scared." Indian mortars and pestles from this same heap were found in the possession of various neighbors, and the site altogether seemed promising for exploration. So, with the permission of the owner, and with such direction as could be given by a historian with an amateur interest in archæology, some Stanford students began to explore the site.

The survey of one of our civil engineers gave us the plot of the mound shown in Fig. 1: a length of four hundred and seventy feet, a width of three hundred and twenty feet, an area of some two acres, and a height of about ten feet in the highest parts. Its

size was notable, and at once made us suspect that this mound had not been built up purposely, but had rather accumulated through the *débris* and the burials of some generations of Indian life and death. All our excavations bore out this idea, thus taking the structure rather out of the category of mounds into that of middens.

The excavations made from time to time resulted in the discovery of some thirty skeletons of both sexes and of all ages,

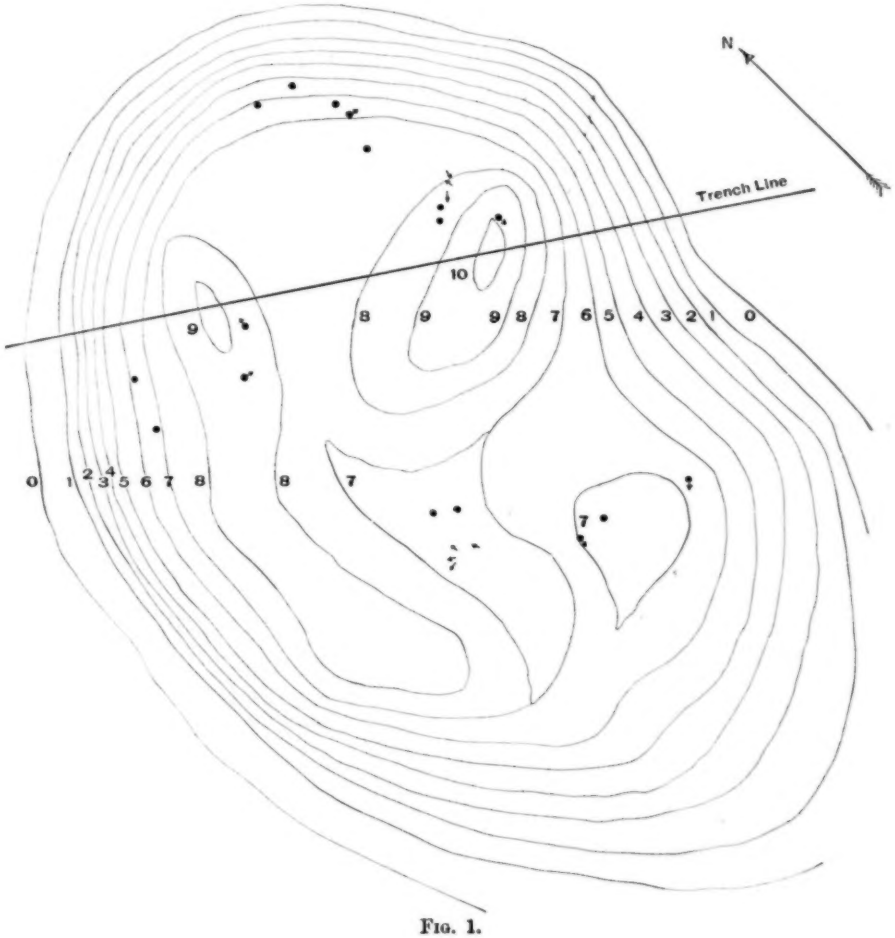


FIG. 1.

many of them undisturbed and often accompanied by various objects of use or ornament. Each cross on Fig. 1 shows the spot from which a skeleton was taken; the arrows indicate the point of the compass toward which the face was turned. The variations in this latter respect furnish negative evidence that the inhabitants of Robles Rancheria had no fixed superstition in connection with the heavenly bodies. It will be seen that there is

hardly any trace of regularity in the interments further than this: the bodies were buried singly and, roughly speaking, in an irregular double circle about the center of the rancheria; they were also buried without previous mutilation or separation, each skeleton being complete. This is again a piece of negative evidence going to prove that cannibalism was not practiced within the tribe; nor in our excavations were any human bones found broken for marrow, or in any situation indicating that they formed a part of the food supply for the Robles Rancheria. Layers of ashes and bits of charcoal were found irregularly throughout every excavation made for a skeleton, but since they were also found throughout the length of a trench run toward the center of the mound, we concluded that they had no special connection with the burial, although it must be added that a few skeletons showed traces of partial burning.

FIG. 2.

The posture of the buried Indians is shown by Fig. 2, from a photograph taken before the skeleton was removed. This posture is common among our North American Indians, and results apparently from the attempt to compress the body into the smallest possible space for burial. Each skeleton excavated showed traces of this posture, except the irregular group to the southwest of the mound, where the bones were found in a very confused state, and where one large and complete skeleton was found interred at full length on its back. No traces of any covering for the body were discovered. Among the skeletons removed one of exceptional interest was very carefully taken out by Mr. Edward Hughes. It was the skeleton of a very old Indian, whose vertebræ had grown together so as to cause a terrible de-

formity. Fig. 3, from a photograph of this skeleton mounted, shows the attitude in which its owner was compelled to live for many years. This ossification had also partially extended to other parts of the body: he could not move his ribs in breathing, he could not lift his head. Another interesting discovery noted by Mr. Hughes was the fact that one of his arms had been broken and most skillfully reset. As Mr. Hughes remarked, the finding of this skeleton, interred, as it had been, carefully, with a fine mortar, two or three bone implements, and an abalone shell, tells us that the former inhabitants of the Robles Rancheria had advanced far enough in civilization to care for the old and decrepit members of their little society. This one at least must have been practically helpless long before his death.

FIG. 3.

The objects interred with the skeletons are made of stone, shell, and bone; of stone implements the mortar and pestle are the most common; in fact, they are surprisingly common, indicating the possession of a great number within the same tribe. They are of the stone found in the immediate neighborhood, with one exception, and are of all grades of finish, as seen in Fig. 4, which shows us all varieties, from the rude bowlder, in which two or more slight concavities have begun to be worn, to the finished mortar, smooth within and without. The most finished mortar of all found was a small one used for grinding paint, shown in Fig. 5. The series of this implement taken from this rancheria furnishes a beautiful illustration of the evolution of what is perhaps the most primitive of human

utensils, the mill. In Fig. 5, *i*, the three pestles show a similar evolution, from the longish pebble to the right, to the purposely shaped large and symmetrical one to the left.

The absence among the stone implements of arrow and spear heads puzzled us greatly, since these objects are very generally

FIG. 4.

found up and down the coast. Only two decided flint arrow points were found in all our work, and these were two broken points of the black obsidian of Napa County, some distance north of the bay, evidently an imported product (Fig. 5, *b*). But on stating our difficulty to Mr. Horatio Rust, of Pasadena, who has made a lifelong study of archæology, especially in California, he informed us that the Indians of this part of the country used wooden points, hardened by fire, for their arrows and spears; these, of course, have perished, and certain it is that in all our valley we do not find these characteristic stone implements. We found, however, in the course of our excavation, many sharp-edged bits of rough flint which may have been used in very primitive work as knives or scrapers; and we did not fail to find those mysterious objects known as "charm stones," since Mr. Yates's careful study has revealed their nature. According to Mr. Yates, who relies on the testimony of old Indians, these stones were a part of the "medicine" of the California tribes, and used in various combinations to bring rain, success in hunting, or in war.* We found no other objects of superstition, unless the

* Charm Stones, the So-called "Plummets" or "Sinkers" of California. By Dr. Lorenzo Gordin Yates. Santa Barbara, California, 1890. Bulletin No. 2 of Santa Barbara Society of Natural History.

ornament seen in the upper right-hand corner of *d'* in Fig. 5 be such. This was a bit of human breastbone, pierced in the center, and suggested at once the idea that it might have been worn as a fetich, or possibly was merely a war trophy—the breastbone of mine enemy.

Bone and shell seem to have furnished the chief material for the tools and ornaments of the inhabitants of this old village. The most common bone implements found were those shown in Fig. 5, *g*, finely pointed and polished from the ulna of a deer's leg. Here, again, as in the mortar and pestle, we find a very early and a very valuable artificial form reached by easy transition from a natural object which was somewhat adapted to the uses aimed at, and which was probably first employed without any endeavor to adapt it artificially. We judged, as a matter of course, that these sharp bone points were used for tipping spears, as they are well adapted to such a purpose; but all the traditions of the neighborhood insist that they were used for ornaments, and that with bunches of bright feathers, attached by strings of sinew, they were stuck into the hair. One bone needle was found, but the small size of this implement and its easy destructibility make it

FIG. 5.

surprising that even one was discovered. One of our most unique finds was a set of bone whistles shown at *a*, Fig. 5. They were made from the long leg bones of some waterfowl, and are evidently intended to furnish a variety of sounds, if we may judge from their varied length and the different positions of their holes.

A passage from Frank Marryatt is interesting in this connection. He says of the Santa Cruz Indians:

"Of an evening they made a great disturbance by indulging in what they intended for a dance; this consisted in crowding together in uncouth attitudes, and stamping on the ground to the accompaniment of primitive whistles, of which each man held one in his mouth, while the women howled and shrieked in chorus." *

With the same skeleton in whose possession were found these primitive pipes of Pan, the saw-toothed bone shown at *c*, Fig. 5, was found. It suggests a saw, but may have been a tally bone, on which count could be kept of years or moons; this use is perhaps indicated by the fact that the notches are only part way along the edge of the bone, and that notched shell, which they also knew how to make, would have been more effective as a saw. A sort of romantic atmosphere seems to surround this especial skeleton, who may have been some sort of primitive historian and musician, furnishing music and keeping the records of the tribe, singing the story of each year as each notch recalled it.

The articles in shell taken from this mound are all of two sorts—shell ornaments or shell money; both are shown at *d*, *d'*, and *e*, in Fig. 5. The shell ornaments are made from the brilliant abalone shell, which is still used to adorn the dooryards of good Californians. The ornaments are either round or oblong disks, pierced at one side for stringing, and all notched very exactly and evenly around the edge—perhaps, as Mr. Hughes suggested, in imitation of the heart shell, of which we found one specimen, shown in *d'*, Fig. 5, next to one of the disk ornaments. The money is like the shell money found all over California, and consists of perforated squares of shell or of small whole shells pierced from end to end, shown at *e*. In this case property and ornament seem to have had a close connection, as perhaps they always have. Aside from the skeletons and the artificial objects found in the Robles Rancheria, we came across many food remains which also tell their story. Bones of deer, elk, raccoon, bones of salmon, and several sorts of waterfowl, countless crabs' claws, mussel, oyster, periwinkle shells in abundance, grouped specially with little beds of ashes, told of good hunting and fireside feasts to follow, in which meat was not lacking to go with the rude bread made from the acorns and seeds ground in the mortars.

Before concluding our work on the Robles Rancheria, we paid a visit to Donna Maria Secundini Robles, and asked her what she knew of this old heap. She is nearly eighty, but remembers well,

* Frank Marryatt. Mountains and Mole-hills, or Recollections of a Burnt Diary, chap. v, p. 83. New York, 1855.

and almost seems to live in, the happy days before the Gringos came. This was her story: When she came as a girl to live on the Robles Ranch, there were three Indian rancherias within a mile of her home, one marked by the mound, and two others not far from the present station of Castro; but the Indians who lived on the mound had already deserted it, for when the Mission Fathers came to Santa Clara, the allegiance of the Indians was soon divided: some welcomed the new life and the new faith, and learned to pray and to hoe corn, to string rosaries, and to weave tule sombreros; while others still chose "the winds of freedom," and thought that acorns, clams, and fetiches would do very well for them. Among those who chose to be wild heathen still were the Indians of the Robles Rancheria; so they left their immemorial village site and went off down the San Joaquin Valley to Tulare, and were never seen again.

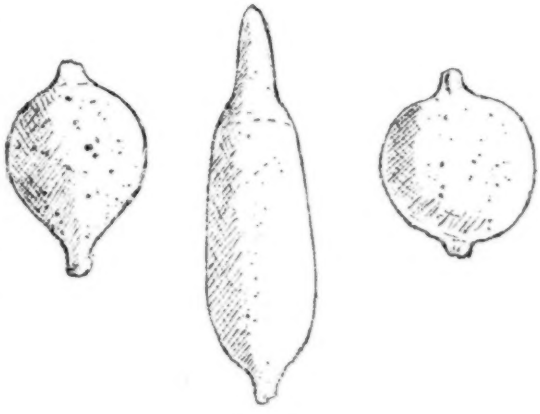


FIG. 6.

This story is confirmed by the fact that in our excavations we found no trace of any trade with whites—no glass beads, no bit of iron; this is noteworthy, since nearly all the known sites of old rancherias in California yield European beads in greater or less plenty. We had, therefore, by great good luck, been excavating a really prehistoric rancheria untouched by any foreign influence. On showing the various objects we had found to Donna Maria, she recognized their use at a glance, with the exception of the charm stones, which puzzled her; she confirmed, however, the statements which we had heard before as to the use of the sharp-pointed bones as hair ornaments. The manners and customs of these Indians were probably much the same as of those who went on living at the two neighboring rancherias, and with the latter Donna Maria was well acquainted, for, as she said, she had "danced with them often when a girl."

Piecing together our finds and the story of Donna Maria, the life of the Robles Rancheria reconstructs itself as follows: A little Indian village lies half hidden in great oak groves near San Francisco Bay, close by a spring oozing up under shady willows; an irregular circle of huts made of poles covered with rushes and

branches shelters its population rather from sun than cold. In the middle of each tepee smolders a little fire, kindled by twirling a stick quickly about in a piece of rotten wood. The inhabitants eat bread made from white-oak acorns, from buckeye and laurel nuts, and, best of all, from manzanita berries. From these same nuts and berries they make *pinole*, a veritable mush, of which the early Spanish explorers constantly speak. They take the bitterness out of the acorns and nuts by soaking them long in water and then allowing them to dry in the sun, spread out on tule mats; then they grind them in their big stone mortars. To the mush and bread they add clams, fish, ducks, deer, and small game; they season their food with salt made from a certain root, and sweeten it by the addition of little sugar cakes, which they buy from the tribes of the mountains, who make them from the sap of some tree. Then there are thimbleberries, chokeweed berries, and in their season the madrona berry; and the tarweed grain made a pleasant variety in their mush and bread. After a feast of clams, tarweed mush, and thimbleberries, they lie about their fires and smoke coyote tobacco from wooden pipes, or dance to the music of their rude bone whistles.

Their dress is a simple apron or short skirt of buckskin, tule, or rabbit skin, with fringes and feathers for adornment, and longer for women; but their ornaments are their chief glory—bracelets, earrings, and necklaces of abalone shells, long, bone bodkins in their thick hair, to which were attached brilliant feathers; and Donna Maria's vivid pantomime shows us how their feathers dance above them as they dance, while their abalone pendants shake about their wrists and necks.

Their weapons are bows, arrows, and spears made of wood, and pointed with bone or flint, bound to a wooden shaft by rawhide, or the tough, sinewy fibers of a shrub which grows up in the mountains.

They made no pottery, but all their grinding, cooking, and carrying was done in stone or basketry; of the latter Donna Maria gave us for the museum a beautiful ancient specimen from one of these very rancherias. It is made of split roots woven so close as to be water-tight, and ornamented by a simple and even classic pattern. Often these baskets were patterned with lines and groups of little feathers, and then they were precious indeed.

When an Indian died, he was wrapped up in a blanket obtained from the missions, and buried in the rancheria itself, but not under the tepee. Before he was buried, the other Indians came and gave gifts and mourned.

A kindly, inoffensive tribe, they lived by hunting, fishing, and the natural nuts and grains of their environment. They ground their food and cooked it, loved music and personal adornment,

held together in their village as a social unit, with a limited commerce. The range of trade indicated by the excavations and confirmed by Donna Maria reveals a narrow world, with a diameter of not much more than twenty miles. The two broken arrowheads from Napa and one broken basaltic lava mortar, whose material must have come from far to the northward, are unique importations to be explained by accident rather than by regular trade, since the other mortars are all made of bowlders easily found in the vicinity, and since, as I have said, the broken arrow points are unique. The hill tribes eastward essentially bounded their world. Tradition and evidence alike show them to be a spur of population entering the valley from the south-

FIG. 7.

ward. Contact with the more warlike and better equipped northern tribes would either have destroyed them or developed their own culture to a higher status of defense.

This low status of defense, the fact that their implements are so similar to the natural objects which suggest them, the low type of skull (Fig. 7), all go to show that the Indian of the Santa Clara Valley was one of the most primitive types known to ethnology within the historic era. The early fathers and voyagers have left a good deal of observation in regard to him, but all this observation is more or less vitiated by the fact that it was made after the contact of Spaniard and Indian had already begun its work. For this reason the evidence of the Robles Rancheria is especially valuable, since it apparently antedates this influence entirely and shows us primitive man in one of his most primitive seats. Nothing possessed or made by the men of the Robles Rancheria indi-

cates that they had ever lived in any other vicinity, or knew any other materials than the bones and stones and shells of their own valley and its encircling hills. Shut off from communication almost as completely as if they had lived on an island, they seem to have lived and died undisturbed from some great antiquity, if we may judge from the height of the mound, which, as a *débris* heap, could only have accumulated slowly. Who knows but that here in the Santa Clara Valley is one of the seats where man first invented a stone mill, first loved the glitter and shine of a lovely shell, first raised his eyes and felt that he was different!

HOW PLANTS AND ANIMALS SPEND THE WINTER.

By W. S. BLATCHLEY,
STATE GEOLOGIST OF INDIANA.

ONE of the greatest problems which each of the living forms about us has had to solve during the years of its existence on earth is how best to perpetuate its kind during that cold season which once each year, in our temperate zone, is bound to come. Many are the solutions to this problem. Each form of life has, as it were, solved it best to suit its own peculiar case, and to the earnest student of Nature there is nothing more interesting than to pry into these solutions and note how varied, strange, and wonderful they are.

To fully appreciate some of the facts mentioned below it must be borne in mind that there is no such thing as "spontaneous generation" of life. Every cell is the offspring of a pre-existing cell. Nothing but a living thing can produce a living thing. Hence every weed that next season will spring up and provoke the farmer's ire, and every insect which will then make life almost intolerable for man or beast, exists throughout the winter in some form.

If we begin with some of the lowly plants, such as the fresh-water algæ, or so-called "frog-spittle" of the ponds, and many of the rusts and fungi which are so injurious to crops, we find that they form in autumn "resting spores." These are very small and globular, one-celled bodies, having a much thicker coat and denser protoplasm or contents than are found in the spores often produced in summer by the same plants, and which are destined for immediate growth. The power of life within these winter resting spores is proof against the severest attacks of frost, and they lie snugly ensconced in the mud at the bottom of pond or stream, or buried beneath the leaves in some sheltered nook, until the south winds of March or April furnish the key to

unlock the castle of the ice king. Then the spirit of growth within each spore begins to assert itself once more, and, bursting the walls, the contents soon produce the parent or summer form of the plant with which we are most familiar. Thus the spores which next season will produce the grape mildew and the red rust of wheat are now in existence, the former within the substance of the fallen grape leaf, the latter within the stubble or about the roots of last season's wheat plants.

If the grape leaves should be carefully gathered and burned, and the stubble destroyed in like manner, not only would the next season's crop of these two parasitic plant pests be wonderfully lessened, but many injurious insects would at the same time be destroyed.

Higher in the scale of plant life we find the flowering annuals bending all their energies during the summer to produce that peculiar form, the "seed," which is only a little plant boxed up to successfully withstand the rigors of winter. The great sunflower, that grows into a giant in a single season and defies the summer sun and storm, falls an easy victim to the frosts of autumn. It, however, prepares the way for many successors in the ripened seeds, each one of which, under favorable conditions, will germinate, grow, reproduce its kind, and thus complete another cycle in the realm of vegetable life. The prospective life and activity of a whole field of next summer's waving corn may be considered as stored up in a few pecks of comparatively lifeless seed corn safely housed in the granary. Within its two protective coats and surrounded by a large store of food, in the form of seed leaf or nucleus, to be used when growth begins again, each little plantlet lives and survives the coldest blasts of King Boreas and his cohorts.

Note, too, the buds and underground stems which will furnish the beginning of next season's growth of our biennial and perennial plants. See how they are protected by heavy overcoats in the form of bud scales. Oftentimes, too, as in the hickory and "balm of Gilead" trees, these scales have a coat of resin or gum on the outside to render them waterproof; and some, as those of the pawpaw, are even fur-lined, or rather fur-covered, with a coating of soft black hairs. Were these protective scales not present, the tender shoots within them, which will furnish the nucleus of next season's foliage, would be seared and withered by the first frost as quickly as though touched with a red-hot iron.

The above are some of the many ways in which our plants, in the course of ages and many changes of environment, have solved the problem of surviving the cold of winter. Moreover, they always prepare for this cold in time, the resting spores and

seeds being ripened and the bud scales formed over the tender tips of the branches long before the first severe frost appears.

Let us now glance at those higher forms of life called animals —"higher," because they are absolutely dependent upon plants for their food—and see how they pass away their time while their food-producers, the plants, are resting.

Beginning with the earthworms and their kindred, we find that at the approach of winter they burrow deep down where the icy breath of the frost never reaches, and there they live during the cold season a life of comparative quiet. That they are exceedingly sensitive to warmth, however, may be proved by the fact that when a warm rain comes some night in February or March, thawing out the crust of the earth, the next morning reveals the mouths of hundreds of the pits or burrows of these primitive tillers of the soil in our dooryard, each surrounded by a little pile of pellets, the castings of the active artisans of the pit during the night before.

If we will get up before dawn on such a morning we can find the worms crawling actively about over the surface of the ground, but when the first signs of day appear they seek once more their protective burrows, and only an occasional belated individual serves as a breakfast for the early birds.

The eyes of these lowly creatures are not visible, and consist of single special cells scattered among the epidermal cells of the skin, and connected by means of a sensory nerve fiber with a little bunch of nervous matter in the body. Such a simple visual apparatus serves them only in distinguishing light from darkness, but this to them is most important knowledge, as it enables them to avoid the surface of the earth by day, when their worst enemies, the birds, are in active search for them.

The fresh-water mussels and snails and the crayfish burrow deep into the mud and silt at the bottom of ponds and streams where they lie motionless during the winter. The land snails, in late autumn, crawl beneath logs, and, burrowing deep into the soft mold, they withdraw far into their shells. Then each one forms with a mucous secretion two thin, transparent membranes, one across the opening of the shell and one a little farther within, thus making the interior of the shell perfectly air-tight. There for five or six months he sleeps free from the pangs of hunger and the blasts of winter, and when the balmy breezes of spring blow up from the south he breaks down and devours the protecting membranes and goes forth with his home on his back to seek fresh leaves for food and to find for himself a mate.

Next in the scale come the insects, which comprise four fifths of all existing animals, and each one of the mighty horde seen in summer has passed the winter in some form. One must look for

them in strange places and under many disguises, for they can not migrate, as do the majority of the birds, nor can they live an active life while the source of their food supply, the plants, are inactive.

The majority of those insects which next May or June will be found feeding on the buds or leaves of our trees, or crawling wormlike over the grass of our lawns, or burrowing beneath the roots of our garden plants, are represented in the winter by the eggs alone. These eggs are deposited in autumn by the mother insect, on or near the object destined to furnish the young, or larvæ, their food. Each egg corresponds to a seed of one of our annual plants, being, like it, but a form of life so fashioned and fitted as to withstand for a long period intense cold; the mother insect, like the summer form of the plant, succumbing to the first severe frost.

Thus myriads of the eggs of grasshoppers are in the early autumn deposited in the ground, in compact masses of forty to sixty each. About mid-April they begin to hatch, and the sprightly little insects, devoid of wings, but otherwise like their parents, are seen on every hand.

A comparatively small number of insects pass the winter in the larval or active stage of the young. Of these, perhaps the best known is the brown "woolly worm" or "hedgehog caterpillar," as it is familiarly called. It is thickly covered with stiff black hairs on each end, and with reddish hairs on the middle of the body. These hairs appear to be evenly and closely shorn, so as to give the animal a velvety look; and as they have a certain degree of elasticity, and the caterpillar curls up at the slightest touch, it generally manages to slip away when taken into the hand. Beneath loose bark, boards, rails, and stones, this caterpillar may be found in midwinter, coiled up and apparently lifeless. On the first bright, sunny days of spring it may be seen crawling rapidly over the ground, seeking the earliest vegetation which will furnish it a literal "breakfast." In April or May the chrysalis, surrounded by a loose cocoon formed of the hairs of the body interwoven with coarse silk, may be found in situations similar to those in which the larva passed the winter. From this, the perfect insect, the Isabella tiger moth, emerges about the last of June. It is a medium-sized moth, dull orange in color, with three rows of small black spots on the body, and some scattered spots of the same color on the wings.

By breaking open rotten logs one can find in midwinter the grubs or larvæ of many of the wood-boring beetles, and, beneath logs and stones near the margins of ponds and brooks, hordes of the maggots or larvæ of certain kinds of flies may often be found huddled together in great masses. The larvæ of a few butterflies

also live over winter beneath chips or bunches of leaves near the roots of their food plant, or in webs of their own construction, which are woven on the stems close to the buds whose expanding leaves will furnish them their first meal in spring.

Many insects pass the winter in the quiescent or pupal stage; a state exceedingly well fitted for hibernating, requiring, as it does, no food, and giving plenty of time for the marvelous changes which are then undergone. Some of these pupæ are inclosed in dense silken cocoons, which are bound to the twigs of the plants upon which the larvæ feed, and thus they swing securely in their silken hammock through all the storms of winter. Perhaps the most common of these is that of the brown Cecropian moth, the large oval cocoon of which is a conspicuous object in winter on the twigs of our common shade and fruit trees. Many other pupæ may be found beneath logs or on the under side of bark, and usually have the chrysalis surrounded by a thin covering of hairs, which are rather loosely arranged. A number pass the cold season in the earth with no protective covering whatever. Among these is a large brown chrysalis with a long tongue-case bent over so as to resemble the handle of a jug. Every farm boy has plowed or spaded it up in the spring, and it is but the pupa of a large moth, the larva of which is the great green worm with a "horn on its tail," so common on tomato plants in the late summer.

Each of the winter forms of insects above mentioned can withstand long and severe cold weather—in fact, may be frozen solid for weeks and retain life and vigor, both of which are shown when warm weather and food appear again. Indeed, it is not an unusually cold winter, but one of successive thawings and freezings, which is most destructive to insect life. A mild winter encourages the growth of mold which attacks the hibernating larvæ and pupæ as soon as, from excess of rain or humidity, they become sickly; and it also permits the continued activity of insectivorous mammals and birds. Thus, moles, shrews, and field mice, instead of burying themselves deeply in the ground, run about freely during an open winter, and destroy enormous numbers of pupæ; while such birds as the woodpeckers, titmice, and chickadees are constantly on the alert, and searching in every crevice and cranny of fence and bark of tree for the hibernating larvæ.

Of the creeping, wingless creatures which can ever be found beneath rocks, rails, chunks, and especially beneath those old decaying logs which are half buried in the rich vegetable mold, the myriapods, or "thousand-legs," deserve more than passing notice. They are typical examples of that great branch of the animal kingdom known as *arthropods*, which comprises all in-

sects and crustaceans. Each arthropod has the body composed of rings placed end to end and bearing jointed appendages, and in the myriapods each ring and its appendages can be plainly seen, whereas in the higher forms of the branch many of the rings are so combined as to be very difficult to make out.

Full forty kinds of myriapods occur in any area comprising one hundred square miles in the eastern United States. About twenty-five of them go by the general name of "thousand-legs," as each has from forty to fifty-five cylindrical rings in the body, and two pairs of legs to each ring. The other fifteen belong to the "centiped" group, the body consisting of about sixteen flattened segments, or rings, each bearing a single pair of legs. When disturbed, the "thousand-legs" always coils up and remains motionless, shamming death, or "playing 'possum," as it is popularly put, as a means of defense; while the centiped scampers hurriedly away and endeavors to hide beneath leaf, chip, or other protecting object. All those found in the Northern States are perfectly harmless, the true centiped, whose bite is reputed much more venomous than it really is, only being found in the South. True, some of the centiped group can pinch rather sharply with their beetle-like jaws, and one, our largest and most common species, a brownish-red fellow about three inches long and without eyes, can even draw blood if its jaws happen to strike a tender place. When handled, it always tries to bite, perhaps out of revenge for the abominably long Latin name given it by its describer. In fact, the name is longer than the animal itself—*Sco-lo-po-cryp-tops sex-spi-no-sa* being its cognomen in full. With such a handle attached to it, who can blame it for attempting to bite? Yet to the scientist up on his Latin each part of the above name bears a definite and tangible meaning. All the myriapods found in the woods and fields feed upon decaying vegetation, such as leaves, stems of weeds, and rotten wood, and in winter three or four species can usually be found within or beneath every decaying log or stump. One species with very long legs is often found in damp houses or in cellars. It is sometimes called the "wall-sweeper," on account of its rapid, ungainly gait, and is even reputed to prey upon cockroaches and other household pests.

Spiders, which do not undergo such changes as do most of the common, six-footed insects, winter either as eggs or in the mature form. The members of the "sedentary" or web-spinning group, as a rule, form nests in late autumn, in each of which are deposited from fifty to eighty eggs, which survive the winter and hatch in the spring, as soon as the food supply of gnats, flies, and mosquitoes appears. The different forms of spiders' nests are very interesting objects of study. Some are

those close-spun, flat, button-shaped objects, about half an inch in diameter, which are so common in winter on the under side of bark, chunks, and flat rocks. Others are balloon-shaped and attached to weeds. Within the latter the young spiders often hatch in early winter, make their first meal off their empty egg cases, and then live together in hunger and harmony until the south winds blow again, when they emerge and scatter far and wide in search of sustenance.

The "wandering" spiders never spin webs, but run actively about and pounce upon their prey with a tiger-like spring. Six or eight of the larger species of this group winter in the mature form beneath logs and chunks, being often frozen solid during cold weather, but thawing out as healthy as ever when the temperature rises. Retiring beneath the loose-fitting bark of hickory or maple trees, a number of the smaller tube-weaving spiders construct about themselves a protecting web of many layers of the finest silk. Within this snug retreat they lie from November until April—a handsome, small, black fellow, with green jaws and two orange spots on his abdomen, being the most common species found motionless within this seeming shroud of silk on a day in midwinter.

In any Northern State as many as four hundred different kinds of the six-footed or true insects, in the winged or adult stage, may be taken in winter by any one who is so disposed, and knows where to search for them. Among the *Orthoptera* there are a half dozen or more grasshoppers which, when full grown, are less than half an inch in length, gray or blackish in color, and with the hard upper crust of the thorax extending the full length of the body and covering the wings. They are called "grouse grasshoppers," and during cold weather they hide beneath the loose bark of logs, or beneath the bottom rails of the old Virginia worm fences. From these retreats every warm, sunny day tempts them forth in numbers. On such occasions the earth seems to swarm with them, as they leap before the intruder, their hard bodies striking the dead leaves with a sound similar to that produced by falling hail. The common field cricket belongs also to the *Orthoptera*, and the young of various sizes winter under rails and logs, bidding defiance to Jack Frost from within a little burrow or pit beneath the protecting shelter.

The true bugs, or *Hemiptera*, hibernate in similar places; squash bugs, chinch bugs, "stink" bugs, and others being easily found in numbers beneath loose bark or hidden between the root leaves of mullein and other plants.

Nearly three hundred species of *Coleoptera*, or beetles, occupy similar positions. Almost any rotten log or stump when broken

open discloses a half dozen or more "horn" or "bess beetles"—great, shining, clumsy, black fellows with a curved horn on the head. They are often utilized as horses by country children, the horn furnishing an inviting projection to which may be fastened, by a thread or cord, chips and pieces of bark to be dragged about by the strong and never lagging beast of burden. When tired of "playing horse" they can make of the insect an instrument of music, for, when held by the body, it emits a creaking, hissing noise, produced by rubbing the abdomen up and down against the inside of the hard, horny wing covers. This beetle passes its entire life in cavities in the rotten wood on which it feeds, and when it wishes a larger or more commodious home it has only to eat the more.

The handsome and beneficial lady beetles winter beneath fallen leaves or between and beneath the root leaves of the mullein and the thistle. Our most common species, the thirteen-spotted lady beetle, is gregarious, collecting together by thousands on the approach of cold weather, and lying huddled up like sheep until a "breath of spring" gives them the signal to disperse. Snout beetles galore can be found beneath piles of weeds near streams and the borders of ponds or beneath chunks and logs in sandy places. All are injurious, and the farmer by burning their hibernating places in winter can cause their destruction in numbers. Rove beetles, ground beetles, and many others live deep down in the vegetable mold beneath old logs, where they are, no doubt, as secure from the breath of the ice king as if they had followed the swallow to the tropics.

Of the *Diptera*, or flies, but few forms winter in the perfect state, yet the myriads of house flies and their kin, which next summer will distract the busy housewife, are represented in winter by a few isolated individuals which creep forth occasionally from crevice or cranny and greet us with a friendly buzz.

In midwinter one may also often see in the air swarms of small, gnatlike insects. They belong to this order, and live beneath the bark of freshly fallen beech and other logs. On warm, sunny days they go forth in numbers for a sort of rhythmical courtship; their movements while in the air being peculiar in that they usually rise and fall in the same vertical line—flitting up and down in a dreamy, dancing sort of motion.

Among the dozen or more butterflies and moths which winter in the perfect state the most common and the most handsome is the "Camberwell Beauty" or "Mourning Cloak," a large butterfly whose wings are a rich purplish brown above, duller beneath, and broadly margined with a yellowish band. It is often found in winter beneath chunks which are raised a short distance above the ground or in the crevices of old snags and fence rails. It is

then apparently lifeless, with the antennæ resting close along the back, above which the wings are folded. But one or two warm days are necessary to restore it to activity, and I have seen it on the wing as early as the 2d of March, hovering over the open flowers of the little snow trillium.

All the species of ants survive the winter as mature forms, either in their nests in the ground or in huddled groups in half-rotten logs and stumps, while here and there beneath logs a solitary queen bumblebee, bald hornet, or yellow jacket is found—the sole representatives of their races.

Thus insects survive the winter in many ways and in many places, some as eggs, others as larvæ, still others as pupæ, and a large number as adults—all being able to withstand severe cold and yet retain vitality sufficient to recover, live, grow, and replenish the earth with their progeny when the halcyon days of spring appear once more.

In the scale of animal life the vertebrates or backboned animals succeed the insects. Beginning with the fishes, we find that in late autumn they mostly seek some deep pool in pond or stream at the bottom of which the water does not freeze. Here the herbivorous forms eke out a precarious existence by feeding upon the innumerable diatoms and other small plants which are always to be found in water, while the carnivorous prey upon the herbivorous, and so maintain the struggle for existence. The moving to these deeper channels and pools in autumn and the scattering in the spring of the assembly which has gathered there constitute the so-called migration of fishes, which is far from being so extensive and methodical as that practiced by the migratory birds.

Many of the smaller species of fishes, upon leaving these winter resorts, ascend small, clear brooks in large numbers for the purpose of depositing their eggs, as, when hatched in such a place, the young will be comparatively free from the attacks of the larger carnivorous forms. Among the lowest vertebrates often found in numbers in early spring in these meadow rills and brooks is the lamprey, or "lamper eel," as it is sometimes called. It has a slender, eel-like body, of a uniform leaden or blackish color, and with seven purse-shaped gill openings on each side. The mouth is fitted for sucking rather than biting, and with it they attach themselves to the bodies of fishes and feed on their flesh, which they scrape off with their rasplike teeth. Later in the season they disappear from these smaller streams, probably returning in midsummer to deeper water. Thoreau, who studied their habits closely, says of them: "They are rarely seen on their way down stream, and it is thought by fishermen that they never return, but waste away and die, clinging to rocks and stumps of

trees for an indefinite period; a tragic feature to the scenery of the river bottoms worthy to be remembered with Shakespeare's description of the sea floor."

A few of the fishes, as the mud minnow and smaller catfishes, together with most frogs, turtles, and salamanders, on the approach of winter, burrow into the mud at the bottom of the streams and ponds, or beneath logs near their margins. There they live without moving about and with all the vital processes in a partially dormant condition, thus needing little if any food.

The box tortoise or "dry-land terrapin," the common toad, and some salamanders burrow into the dry earth, usually going deep enough to escape the frost, while snakes seek some crevice in the rocks or hole in the ground where they coil themselves together, oftentimes in vast numbers, and prepare for their winter's sleep. If the winter be an "open" one this hibernation is sometimes interrupted, and the animal issues forth from its retreat on a warm, sunny day, thinking, no doubt, that spring has come again.

Thus the writer has, on one occasion, seen a soft-shelled turtle moving gracefully over the bottom of a stream on a day in late December, and has in mid-January captured snakes and salamanders from beneath a pile of driftwood where they had taken temporary refuge.

With frogs especially this hibernation is not a perfect one, and there is a doubt if in a mild winter some species hibernate at all. For example, the little cricket frog or "peeper" has been seen many times in midwinter alongside the banks of flowing streams, and during the open winter of 1888–'89 numerous specimens of leopard and green frogs were seen on different occasions in December and January, while on February 18th they, together with the peepers, were in full chorus.

Of our mammals, a few of the rodents or gnawers, as the ground-hogs, gophers, and chipmunks, hibernate in burrows deep enough to escape the cold, and either feed on a stored supply of food, or, like the snakes and crayfish, do not feed at all.

Others, as the rabbits, field mice, and squirrels, are more or less active and forage freely on whatever they can find, eating many things which in summer they would spurn with scorn. To this class belongs that intelligent but injurious animal the musquash or muskrat. Those which inhabit the rivers and larger streams live in burrows dug deep beneath the banks, but those inhabiting sluggish streams and ponds usually construct a conical winter house about three feet in diameter and from two to three feet in height. These houses are made of coarse grasses, rushes, branches of shrubs, and small pieces of driftwood, closely cemented together with stiff, clayey mud. The top of the house usually projects two feet or more above the water, and when sun-dried is so

strong as to easily sustain the weight of a man. The walls are generally about six inches in thickness and are very difficult to pull to pieces. Within is a single circular chamber with a shelf or floor of mud, sticks, leaves, and grass, ingeniously supported on coarse sticks stuck endwise into the mud after the manner of piles. In the center of this floor is an opening, from which six or eight diverging paths lead to the open water without, so that the little artisan has many avenues of escape in case of danger. These houses are often repaired and used for several winters in succession, but are vacated on the approach of spring. During the summer the muskrat is, in the main, a herbivorous animal, but in the winter necessity develops its carnivorous propensities and it feeds then mainly upon the mussels and crayfish which it can dig from the bottom of the pond or stream in which its house is built.

The bats pass the winter in caves, the attics of houses and barns, or in hollow trees, hanging downward by their hind claws, eating nothing and moving not. All the carnivora, or flesh-eaters, as the mink, skunk, opossum, fox, and wolf, are in winter active and voracious, needing much food to supply the necessary animal heat of the body. Hence they are then much more bold than in summer, and the hen yard or sheep pen of the farmer is too frequently called upon to supply this extra demand.

But of all our animals it seems to us the birds have solved the winter problem best. Possessing an enduring power of flight and a knowledge of a southern sunny sky, beneath which food is plentiful, they alone of the living forms about us have little fear of the coming of the frost. True, forty or more species remain in each of the Northern States during the cold season, but they are hardy birds which feed mainly on seeds, as the snow bird and song sparrow; on flesh, as the hawks and crows; or on burrowing insects, as the nuthatches and woodpeckers. And no winter day is too dull and dreary, no sky too leaden and cheerless, no north wind too harsh and biting for them to be on the lookout for food.

Such are some of the solutions to the problem of life in winter which the plants and animals about us have worked out; such some of the forms which they undergo, the places which they inhabit.

To the thinking mind a knowledge of these solutions but begets other and greater problems, such as how can a living thing be frozen solid for weeks and yet retain vitality enough to fully recover? How can a warm-blooded animal sleep for months without partaking of food or drink? And, greater than either, What is that which we call life?

I hold in my hand two objects, similar in size, color, organs,

everything—twins from the same mother in all outward respects. One pulsates and throbs with that which we call "life." It possesses heat, bodily motion, animal power. The other is cold, motionless, pulseless, throbless—a thing of clay. What is that "life" which the one possesses and the other lacks? Ah, there's the rub! With the wisest of men we can only answer, "*Quien sabe?*" (Who knows?)

THE INTERPRETATIONS OF AUTOMATISM.

By Prof. WILLIAM ROMAINE NEWBOLD.

THROUGHOUT this series of papers I have confined myself closely to one theory of interpretation, and I have done so because the theory which I adopted stands nearest to those of current science. To leave the subject in this shape, however, would be an injustice both to my readers and myself. The phenomena the reality of which I have acknowledged constitute but a part of those which are regarded by competent observers as actually entering into the question; and the solution which I have proposed is not only with difficulty capable of reconciliation with these other phenomena, but is itself based upon a metaphysical theory which is far from demonstration. It seems, therefore, no more than fair that I should, before concluding my series, give my readers a somewhat broader outlook upon the various aspects of the problem than I have yet done. A complete survey of all theories that have been proposed to account for the whole or a part of the facts can not, of course, be given in a magazine article, even if I were competent to the task, which I do not profess to be. But some account of the manner in which the phenomena of suggestibility and automatism are related to the broader field of the supernormal, and of the possible points of view from which the whole field may be surveyed, seems to me essential.

There is no need of my again recounting the salient features of suggestibility, automatism, and secondary states. Let me turn at once to the material which I have hitherto excluded—the realm of the supernormal.

It is with some hesitation that I have resolved to introduce any discussion of these topics in the pages of the Popular Science Monthly. The inquiry into the supernormal is as yet in its infancy: its methods are still crude, and its results are under discussion. None of these results have as yet won the right to a place among the scientific truths which may be regarded as *known*. They are still the personal opinions of a small group of students, and although I account myself one of the group, I do not make the mistake of identifying my personal opinions with

strong as to easily sustain the weight of a man. The walls are generally about six inches in thickness and are very difficult to pull to pieces. Within is a single circular chamber with a shelf or floor of mud, sticks, leaves, and grass, ingeniously supported on coarse sticks stuck endwise into the mud after the manner of piles. In the center of this floor is an opening, from which six or eight diverging paths lead to the open water without, so that the little artisan has many avenues of escape in case of danger. These houses are often repaired and used for several winters in succession, but are vacated on the approach of spring. During the summer the muskrat is, in the main, a herbivorous animal, but in the winter necessity develops its carnivorous propensities and it feeds then mainly upon the mussels and crayfish which it can dig from the bottom of the pond or stream in which its house is built.

The bats pass the winter in caves, the attics of houses and barns, or in hollow trees, hanging downward by their hind claws, eating nothing and moving not. All the carnivora, or flesh-eaters, as the mink, skunk, opossum, fox, and wolf, are in winter active and voracious, needing much food to supply the necessary animal heat of the body. Hence they are then much more bold than in summer, and the hen yard or sheep pen of the farmer is too frequently called upon to supply this extra demand.

But of all our animals it seems to us the birds have solved the winter problem best. Possessing an enduring power of flight and a knowledge of a southern sunny sky, beneath which food is plentiful, they alone of the living forms about us have little fear of the coming of the frost. True, forty or more species remain in each of the Northern States during the cold season, but they are hardy birds which feed mainly on seeds, as the snow bird and song sparrow; on flesh, as the hawks and crows; or on burrowing insects, as the nuthatches and woodpeckers. And no winter day is too dull and dreary, no sky too leaden and cheerless, no north wind too harsh and biting for them to be on the lookout for food.

Such are some of the solutions to the problem of life in winter which the plants and animals about us have worked out; such some of the forms which they undergo, the places which they inhabit.

To the thinking mind a knowledge of these solutions but begets other and greater problems, such as how can a living thing be frozen solid for weeks and yet retain vitality enough to fully recover? How can a warm-blooded animal sleep for months without partaking of food or drink? And, greater than either, What is that which we call life?

I hold in my hand two objects, similar in size, color, organs,

everything—twins from the same mother in all outward respects. One pulsates and throbs with that which we call "life." It possesses heat, bodily motion, animal power. The other is cold, motionless, pulseless, throbless—a thing of clay. What is that "life" which the one possesses and the other lacks? Ah, there's the rub! With the wisest of men we can only answer, "*Quien sabe?*" (Who knows?)

THE INTERPRETATIONS OF AUTOMATISM.

By Prof. WILLIAM ROMAINE NEWBOLD.

THROUGHOUT this series of papers I have confined myself closely to one theory of interpretation, and I have done so because the theory which I adopted stands nearest to those of current science. To leave the subject in this shape, however, would be an injustice both to my readers and myself. The phenomena the reality of which I have acknowledged constitute but a part of those which are regarded by competent observers as actually entering into the question; and the solution which I have proposed is not only with difficulty capable of reconciliation with these other phenomena, but is itself based upon a metaphysical theory which is far from demonstration. It seems, therefore, no more than fair that I should, before concluding my series, give my readers a somewhat broader outlook upon the various aspects of the problem than I have yet done. A complete survey of all theories that have been proposed to account for the whole or a part of the facts can not, of course, be given in a magazine article, even if I were competent to the task, which I do not profess to be. But some account of the manner in which the phenomena of suggestibility and automatism are related to the broader field of the supernormal, and of the possible points of view from which the whole field may be surveyed, seems to me essential.

There is no need of my again recounting the salient features of suggestibility, automatism, and secondary states. Let me turn at once to the material which I have hitherto excluded—the realm of the supernormal.

It is with some hesitation that I have resolved to introduce any discussion of these topics in the pages of the Popular Science Monthly. The inquiry into the supernormal is as yet in its infancy: its methods are still crude, and its results are under discussion. None of these results have as yet won the right to a place among the scientific truths which may be regarded as *known*. They are still the personal opinions of a small group of students, and although I account myself one of the group, I do not make the mistake of identifying my personal opinions with

ascertained fact. Still, the relation between these phenomena and those of automatism in particular is so close that no student of the one group can ignore the other.

Alleged supernormal phenomena may be regarded as belonging to two classes—psychical and physical. The latter class embraces all alleged interferences with the known laws of the physical world. They may be dismissed from consideration here, not merely because they are not relevant, but because nearly every case so far reported has dissolved into fraud or malobservation upon closer examination, and the few which remain intact can not, in consequence, be regarded as proving anything.

By psychical phenomena I mean mental occurrences which either give true indications of events unknown to the percipient, or seem in some way to coincide with and suggest such events, or, in the case of impulses, seem to betray a knowledge of fact which was not possessed by the subject of the experience. These, again, may be subdivided into several groups. In the telepathic group the circumstances are such as to suggest a species of mental induction, one mind reflecting the thoughts of another. Thus a friend of mine was walking down a country road near Germantown, Pa., on a hot summer's day. Suddenly he found himself thinking, "Where can I find a doctor, where can I find a doctor?" He laughed at the absurdity—as if he wanted one—but, to be sure, if he did, where could one be found? Dr. Y—— was dead, and the only other he knew of was Dr. Z——, at Jenkintown. A few moments later he reached a crossroad, along which a man and boy were driving rapidly. As they met my friend, the man reined in the horse, leaned out, and said, "Can you tell me, sir, where I can find the nearest doctor?"

Nine times in the course of my own life I have had what is called a "presentiment." Eight times I wrote it down at once before learning whether it was true or false, and the ninth time I spoke of it. Three of these were false, one was partly true and partly false, one was not verified, but probably false. All these related to subjects much in my thoughts, and were probably suggested by circumstances. Four were true, of which one might have been suggested by circumstances. The other three were not only true and not apparently suggested by circumstances, but were among the most agitating experiences of my life. One drove me, in spite of the resistance of my reason, to take a journey which seemed the act of a lunatic, and proved the wisest thing I could do. Another impelled me to write a letter to a person three hundred and fifty miles away, to whom I had written a few hours before, but who happened to be in great trouble at the moment I felt the impulse. The third gave me absolute assurance that the very thing was about to happen which I believed

to be of all things most impossible. I do not, of course, quote these few experiences as proving the existence of telepathy, but merely as illustrating what I mean by "apparently telepathic phenomena."

The vast majority of apparently supernormal phenomena are susceptible of a telepathic explanation, but in a few cases one is driven to other conceptions. Sometimes knowledge is shown of events not known to any one, and at other times a percipient will seem to "see" things at a distance, or to become aware of events remote in time.

These phenomena are ascribed to "clairvoyance," "precognition," and "retrocognition." They are much less common than those of the telepathic type, and the evidence for them is by no means as good.

Occasionally the information thus got professes to come from the spirit of some person deceased, and sometimes the claim seems plausible. Thus I once got from an automatic writer in Boston what purported to be messages from several of my deceased relatives, one of them being an aunt who died in my childhood, twenty-one years ago. Among the messages was an allusion to "Carson the Dr." This meant nothing to me at the time, but upon making inquiries I learned that an old doctor named *Corson* had attended my aunt during her last illness for about two weeks while she was at our house, although he was not her regular physician. She was afterward removed to a hospital in New York, and died there. The doctor has long been dead. I do not quote this to prove that the spirit of my aunt was really there, which I think very questionable, but to show how plausible these automatic utterances sometimes are. Probably my parents were the only persons living who knew that Dr. Corson attended my aunt for two weeks in 1875, and they have never seen the automatist.

Now, psychic phenomena nearly always occur in automatic form. Ungrounded emotions, inner or outer voices, apparitions, automatic writing and speech, irrational impulses—all these provide the garb for the appearance of knowledge for which we can not account. Hence it is impossible to study automatism without taking these alleged phenomena into consideration at some stage of the inquiry, even if they are considered only to be rejected.

There are three practicable methods of viewing the facts of suggestibility, automatism, and secondary states. In the first place, we may adopt the conception which underlies most of our modern thought, and regard mind as essentially a function of matter—that is, of the brain. We will then naturally look to physiology only for our explanation of these facts. Or we may hold to the purely psychological point of view, and endeavor to

explain the phenomena by reference to psychological principles only. Or, finally, we may adopt the time-honored doctrine which regards mind and brain as two distinct entities, between which constant interaction is going on. We may then invoke both principles in our theories.

The first of these doctrines is commonly known as materialism, but as that word has been so much abused I shall use the phrase "theory of dependence." It has its root in the obvious fact that sensations and emotions are caused by physical and physiological processes. Recent physiological research has tended to establish this doctrine more firmly, to extend its scope and to determine the character of the relation. There is much evidence to show that thought, reason, and will are also dependent upon the brain for their very existence; that all mental states are especially connected with the cortex of the brain; that even some very complicated movements, to the performance of which we usually suppose consciousness to be essential, can be performed by lower, presumably unconscious, centers. All this tends to exalt our idea of the brain's capacities and to diminish the importance ascribed to mind. Moreover, careful psychological work has shown that many of what are termed mental laws are most easily explained as representing physical processes, and the sharp antithesis which we draw between the laws of mind and those of matter is in part at least illusory. The law of association is believed to be capable of interpretation in terms of the transmission of nervous impulses through the cortex, the laws of volition in their simpler forms point to a direct discharge of energy developed in connection with some substantive mental state into the subcortical mechanism and thence to the muscles, the law of attention suggests some species of coalescence of all the activities going on at one time in the cortex into a definite system. Even telepathy, which is regarded with so much suspicion by orthodox psychologists, is parallel to the phenomena of induction.

The more special lines of work, therefore, both in physiology and psychology, tend to converge upon the same conclusion to which we are already predisposed by the general drift of the intellectual movement initiated by Gassendi, Hobbes, Descartes, Galileo, and Newton—that it is to matter we must look for our knowledge of Nature, that material processes are independent and self-sufficient, that mind is merely a brain product, which waxes and wanes with the flow and ebb of physical activities within the cortex.

The attempts that have been made to explain some or all of the phenomena of suggestibility and automatism by reference to physical changes are almost innumerable, and scarcely any conceivable attribute of the brain or its functions has not been

seized upon by somebody. One refers hypnotic states to excessive blood supply, another to diminished blood supply, another to accumulation of waste products in the blood, another to inhibition of the association paths, another to inhibition of the frontal region, another to inhibition of one hemisphere, another to inhibition of the entire cortex, and so on. There may be an element of truth in some of these theories, but it is certain that no one is sufficient to account for all the facts, even if the alleged supernormal facts be excluded as non-proved.

In fact, we know very little indeed about the brain processes which are immediately related to consciousness, and consequently many psychologists are reluctant to resort to them for explanations of what goes on in consciousness. They prefer to limit the inquiry to the facts and laws of mind and to formulate the phenomena of suggestibility and automatism in mental terms alone. It is not possible for me to analyze these theories here, as each presupposes a knowledge of the particular psychological point of view from which it is conceived. The ideas of inhibition of attention, interference with association, inhibition of will, influence of imagination and expectation, figure largely in all these theories. That which I have been developing in these pages belongs to this type, but is distinguished by its free use of conceptions derived from the theory of dependence. Assuming that consciousness depends upon and indicates the existence of physical processes, that these physical processes have the attributes of other physical forces, that they in some way coalesce and interact in the brain cortex, I borrowed these physical conceptions and applied them directly to those mental phenomena which we regard as dependent upon the physical. Thus, if the simultaneous grasping of several mental facts indicates a coalescence of their physical bases, and *vice versa*, then inability to become conscious of any mental fact the physical basis of which we have reason to believe exists would indicate that its physical basis had failed to coalesce with the others. In such cases I described the mental fact as itself "cut off from" or "dissociated from" the other mental states, although, manifestly, mental states, which do not themselves occupy space, can not be spatially cut off from or separated from anything whatever. The phenomena of suggestibility I ascribed to the removal through this dissociation of the checks and counterchecks exerted by mental states upon one another, thus allowing suggested sensations and ideas to work out their results more freely than usual.

Analogous conceptions have been worked out by other writers without explicit reference to the physical basis of consciousness. Thus, Dr. Hans Schmidkunz, in a bulky and learned but badly written book (*Psychologie der Suggestion*, Munich, 1892), makes

free use of the conception of consciousness as a co-ordination of forces capable of occasional disruption, although he seems to have been led to that notion by the Herbartian psychology. Professors Janet and Binet also teach analogous doctrines without reference to the brain processes, and Prof. William James seems at times to hold a similar position.

In sharp antithesis to the theory of dependence stands the theory of independence. According to this doctrine, mind and matter are essentially distinct in nature, and are capable of independent existence, although in fact sometimes closely related. Many mental states, as sensations, are caused by physical processes, and, *vice versa*, many physical processes, as some bodily movements, are caused by mental states; but this relation of action and interaction is purely accidental, and can be dissolved without the destruction of either mind or matter. This theory has been stated in many forms, and is involved more or less implicitly in many philosophies. In one form or another it has been the dominant theory in every epoch of human thought, it lies at the foundation of most religions, and is to-day accepted by the mass of men; yet in the scientific world it has fallen into such disfavor that in many circles it is almost as disgraceful to avow belief in it as in witchcraft or ghosts.

The chief argument usually alleged in justification of this attitude is that the theory of independence violates the law of conservation of energy, which is justly regarded as one of the greatest scientific generalizations of this century. That law requires that in all the manifold flux of physical phenomena certain definite and quantitative relations should exist between the amount of work done and the amount of energy expended, thus binding all physical processes into a closed series. To admit mental phenomena into that series as a mode into which physical energy might be transformed, would, it is claimed, break the law—first, because the new elements are non-physical, and it is inconceivable that the non-physical should affect the physical; and, second, because mental states can not be measured, and therefore can not constitute an equivalent of anything,

This *a priori* objection does not seem to me to possess much force. The argument from inconceivability has been urged against every new conception introduced into science; it was never more weighty then when hurled against the bold speculators who claimed that the earth was round and that the antipodes nevertheless did not fall off. That a thought should cause the disintegration of a molecule is intrinsically neither more nor less inconceivable than that a disturbance in an imponderable entity like ether should shatter an oak tree. What is inconceivable to one generation becomes the commonplace of the next.

What the objectors really mean is that such a relation is *incomprehensible*, which it certainly is, but so also are all natural phenomena when reduced to their lowest terms.

The argument from equivalence is of greater weight, but is not conclusive. Mental states, it is true, have never yet been measured, nor are they likely to be; but we have no right to assume that quantitative relations are the only relations of which the law of conservation of energy can take cognizance. As quantity is an essential attribute of matter, so is quality an essential attribute of mind, and we may discover that, *mutatis mutandis*, the law of equivalence holds—that every given quantity and kind of energy expended in the cortex has its fixed equivalent in a given *quality* of consciousness, that is, in some definite kind of sensation, thought, or emotion, and *vice versa*.

It should be observed that the argument from the law of conservation of energy overthrows both the theory of independence and that of dependence, and we are reduced to the contemplation of the relation of mind and matter as an inscrutable mystery—a mystery which some philosophers try thinly to veil, by invoking the good offices of a third unknown substance of which both matter and mind are supposed to be attributes. This is the so-called doctrine of monism.

I have thought it necessary to go into this argument to some degree because without some such explanation my readers may wonder why I regard the theory of independence as entitled to any hearing whatever. Yet I think that the disrepute into which it has fallen is not due to any imaginary conflict with the law of conservation of energy. It is in part due to the general drift of our age, which for nearly four hundred years has set away from the supranaturalistic conceptions of the middle ages toward naturalism, and has consequently left the doctrine of independence, which was universal throughout the middle ages, high and dry on the sands. It is for the most part, however, due to the direct evidence, of which I have above spoken, for the dependence of mind upon the body.

It is not my purpose to attempt to prove or to disprove either of these theories, but before proceeding to interpretations of automatism which may be based upon the latter, I may point out that the evidence is not so wholly one-sided as is commonly supposed. The clinical facts by no means warrant the assumption that mental degeneration necessarily keeps pace with brain destruction. Cases are frequently reported in which patients survive severe and permanent injuries to the brain with relatively slight mental impairment. Some of the phenomena of normal psychology, as the consciousness of self, attention, and will, are as easily interpreted from the one as from the other point of view; and in

the supernormal field the facts already reported, should they be substantiated by further inquiry, would go far toward showing that consciousness is an entity governed by laws and possessed of powers incapable of expression in material conceptions.

I do not myself regard the theory of independence as proved, but I think we have enough evidence for it to destroy in any candid mind that considers it that absolute incredulity as to its possibility which at present characterizes the average man of science.

Now, if it were proved true, what explanations can it provide for the phenomena of suggestibility and automatism?

The simplest way of looking at the facts is to ascribe them to a *partial separation* of mind and body. This notion is based upon the fact that the memory of the secondary state is so often lost. The mind may be supposed to be asleep while another person plays upon the sensitive machine which it has just been using. When memory is retained, we may suppose that consciousness, upon being reunited to its body, reads off, as it were, the traces left in the brain by what was going on in its absence. This is the notion which the very word automatism connotes, and it has been held more or less clearly by many writers. It accounts very well for most of the facts of hypnotic states, for the simpler forms of post-hypnotic suggestion, and is especially suggested by hysterical losses of sensation and movement, and by successive personalities. The same fundamental conception may be interpreted in accordance with the theory of dependence by ascribing all these phenomena to brain processes of *too low a degree of intensity* to awaken consciousness.

But this notion breaks down when applied to the more advanced stages of motor automatism, as fully developed automatic writing, to simultaneous personalities, to the more advanced forms of post-hypnotic suggestion, to trance and ecstasy. In all these cases we have as good evidence for the existence of consciousness as we ever have, save that the consciousness which we infer does not become a part of some recognized person's memories. Consequently we must admit either that organized matter, or some *tertium quid* which is neither mind nor matter, is capable of producing the effects which we ascribe to consciousness, or else that there sometimes exists in connection with a given body a consciousness distinct from that known to us.

The first of these alternatives would practically bring us back to the theory of dependence. The second, the doctrine of a *tertium quid*, is found in many writers, although there is no agreement as to the characteristics of the third entity. This notion is indeed descended from the ancient distinction between body, soul, and spirit. The *tertium quid* is usually conceived as a semimaterial

entity, akin in its nature to the physical substratum of light and electricity. The doctrine of the "astral body" belongs to this type. Or, the third entity may be conceived as akin to consciousness in its essential nature, although capable of separation from it. It may, for example, be identified with the life of sensation and sensuous desires which common sense discriminates from the "more spiritual" elements of thought, reason, and will.

If the third alternative be adopted, we must regard the principle which lies at the foundation of such phenomena as purely mental. The oldest form of this theory is the doctrine of possession, which ascribes all automatism to the agency of some adventitious mind, as that of a demon or spirit, entering into the body of the patient and assuming control, to the total or partial exclusion of its rightful owner.

In modern times the doctrine has assumed the form of "duplex personality." This theory maintains that in every man there are two minds, one known to us and one usually unknown.* To the latter are ascribed all the phenomena of suggestibility and automatism, sometimes also telepathy, clairvoyance, and the like, and even the power of moving furniture, of objectifying and "materializing" its ideas, and of performing the other tricks which "mediums" ascribe to spirits.

A similar theory has been developed by Mr. F. W. H. Myers in a series of papers in the Proceedings of the Society for Psychical Research. Mr. Myers avoids the words soul, spirit, and the like in stating his theory, on account of their crude associations, but I shall in this popular sketch make use of these familiar words, even at the risk of misrepresenting him a little.

Mr. Myers agrees with the other representatives of the soul theory in acknowledging the existence of a spiritual entity of some sort, although he does not define it or attempt to fix its relation to matter. Its essence is consciousness; but—and this is the point characteristic of the theory—the consciousness of which my soul consists is not identical with what I call my consciousness. Every soul is the basis or ground of existence of many wholly distinct consciousnesses of which the consciousness I call mine is but one. It is not even the most important of them, although it also is not the least important. It has been evolved by a process of selection out of an infinity of possible elements solely on the ground of utility. Its function is the preservation of the body; those mental elements which were found most directly to

* Some writers who hold to the doctrine of dependence have embraced a similar view, and regard the two minds as produced by the right and the left hemispheres of the brain respectively, and other duplex theories have been stated from the purely psychological point of view.

subserve that end have been discriminated from the others under the stress of natural selection and organized into a conscious system. The others have either been forced out, as their places were needed by more important elements, or have never got in, because they could not compete with the others in point of utility.

Among those which have been forced out, their functions being relegated to the nervous mechanism, are the powers of voluntarily controlling the involuntary muscles, the processes of secretion, absorption, assimilation, excretion. In many persons all vivid imagery has in like manner been lost. Among those which have never been received into the normal consciousness are those which we vaguely term genius, and also telepathy, clairvoyance, and probably an infinity of other modes of cognizing reality.

For all this infinite wealth of thought and experience which Mr. Myers believes to exist outside the narrow bounds of the upper consciousness he proposes the term "subliminal states." They embrace every type of consciousness known to us, from the most filmy and incoherent of dreams to the most sublime flights of genius, and many more of which we have never framed a conception. Sometimes they flow along in distinct streams, each with its own memory and desires; at others they blend into more complex wholes.

In the curious phenomena which I have been studying, and in many more which I have not taken into consideration, Mr. Myers believes we have manifestations of one or more of these hidden streams. In all forms of automatism the subliminal material is forced into the upper consciousness much as a stream of lava is forced through the earth's crust. The material itself may be nonsense or a revelation, but the mechanism is in all cases the same. In sleep, dream, hypnosis, trance, and ecstasy we see a temporary subsidence of the upper consciousness and the upheaval of a subliminal stratum.

We need not suppose that our selves are always to consist of this conglomerate of disorganized material. We may believe that in some future life harmony will succeed discord; all the scattered portions of our psychical selves will be reunited into a new and higher synthesis—a self more rich in memories, more alive to its environment, more strong in action than any we can now imagine.

Of all the theories developed from the point of view of the doctrine of independence, Mr. Myers's is the most comprehensive in its scope, is kept in most constant touch with what the author regards as the facts, and displays the greatest philosophic insight; but its very comprehensiveness may well make us hesitate. We must make theories—they are the very eyes of the student—but

we must be slow in adopting them. The inquiry into the supernormal has but just begun, the support of the great body of scholars has not by any means been won, and the fundamental facts are still in question. The first need is more observation and more experiment. The theories framed by Mr. Myers and others will serve as guides in the inquiry, and in future, as facts accumulate, what there is in them of value will become manifest.

TENDENCIES IN ATHLETICS FOR WOMEN IN COLLEGES AND UNIVERSITIES.*

By SOPHIA FOSTER RICHARDSON.

FROM correspondence with the leading colleges and universities which educate women, I find that they have very generally introduced, or are preparing to introduce as far as possible, physical training and athletic sports.

I find, too, from this correspondence that if I describe the conditions at Vassar, where I am most familiar with them, I shall describe the general tendencies in athletics for women.

From the beginning Vassar has required practice in the gymnasium and an hour of outdoor exercise daily from every student throughout her course. A riding school was provided and a bowling alley, and the lake furnished boating of a mild type. There was not sufficient interest in riding to maintain the school, and after a few years it was given up. The bowling alley atrophied and fell off as a member of the body academic. The hour of outdoor exercise has been very generally spent in walking. The result of this daily practice is that members of the upper classes can *walk*, so that when the Professor of English at one time introduced the delightful custom of annually inviting fifteen or twenty seniors to accompany him on an autumnal tramp of from ten to twenty miles through the highlands of the Hudson, the invitation was always accepted with enthusiasm and the walk greatly enjoyed.

About twenty years ago, when I was a freshman, seven or eight baseball clubs suddenly came into being, spontaneously as it seemed, but I think they owed their existence to a few quiet suggestions from a resident physician, wise beyond her generation. The public, so far as it knew of our playing, was shocked, but in our retired grounds, and protected from observation even in these grounds by sheltering trees, we continued to play in spite of a censorious public. One day a student, while running be-

* A paper presented to the Association of Collegiate Alumnæ, October 31, 1896.

tween the bases, fell, with an injured leg. We attended her to the infirmary, with the foreboding that this accident would end our play of baseball. Not so. Dr. Webster said that the public would doubtless condemn the game as too violent, but that if the student had hurt herself while dancing the public would not condemn dancing to extinction. Singular point was given to her remark a few days later, when a student did fall while dancing and broke her leg. After this we played with the feeling somewhat lightened that we were enjoying delightful but contraband pleasure. The interest in baseball did not increase; clubs were not formed by incoming classes. I think there was too much pressure against it from disapproving mothers. However, those of us who had learned the value of vigorous play succeeded in keeping alive enough interest in the game to support two clubs until our senior year. This year saw the advent of tennis at college.

Knowing as I do that I owe to the regularity of college life and to vigorous play an excellent health record since graduation, it is difficult for me to conceive the point of view of those, if there be such, who disapprove of athletics for girls.

Tennis, being more conventional than baseball, at once gained, and has steadily maintained, a hold upon the students. A tennis association was organized, many courts were prepared, and an annual tournament, in competition for the college championship, was instituted.

The primitive calisthenics of the gymnasium have long since given place to scientific physical training, and a modern gymnasium has been built.

About seven years ago, through the generosity of Mr. Rockefeller, facilities were provided for flooding the lake. The skating season was thereby extended from a precarious duration of a week or two, contingent on the snowfall, to a reasonably certain period of six or eight weeks. As soon as these conditions were established, large numbers of students learned to skate. I think probably two thirds of the college now enjoy this sport.

A few years ago athletic games were introduced in connection with the work of the gymnasium. The students were taught battle-ball and basket-ball in the gymnasium, golf links were prepared and golf clubs procured. Battle-ball was discarded, as it did not prove a good game for outdoors. Golf, I believe, was voted uninteresting, and accordingly neglected, and I learn that it has not yet found favor with any of the colleges. It is thought that as golf becomes better known throughout the country, and students learn it before coming to college, they will play more at college.

Basket-ball has been enthusiastically received with us, as with all the colleges. Each class has a team and substitutes, and inter-

class contests are held. An athletic association has been organized by the students, and an annual field day has been observed, when there have been contests in field and track athletics.

If there be those who assume that physical excellence is the attribute of the so-called "new woman," and therefore unwomanly, we can only reply that the idea that women should have the same physical training as men is no newer than Plato's Republic, wherein the Greek sage insists that the women should have the same physical training as the men, that the race might be continued in the highest perfection of mental and physical vigor. Little is told us of the education of girls in Greece; but this we know—that Spartan girls were subjected to a course of training differing from their brothers only in being less severe. They had their own exercise grounds, in which they learned to leap, run, cast the javelin, throw the discus, play ball, wrestle, dance, and sing. The result of this fine physical training was not only health and strength, but beauty; for it is a well-attested fact that the daughters of Sparta were handsomer and more attractive than the more delicately nurtured Athenians. In Aristophanes, Lampito, a Spartan woman, excites the jealous admiration of the Athenian women because of her beauty. When some one said to Gorgo, the wife of Leonidas, "You Spartans are the only women who rule men," she proudly replied, "Because we are the only women who bring forth men."

In behalf of the introduction of games as supplementary to the work of the gymnasium, I will quote Miss Hill, of the Wellesley Gymnasium: "Four years ago I began to give my services to the college in organized 'sports and pastimes' in connection with the department, feeling that we were giving in America too much attention to artificial exercises and too little to the development of the play instinct, which is the natural means of recreation. I believe in gymnastics for girls for their *corrective* value and as an antidote to the faulty postures we take so much, the effects of wrong clothing, etc., lack of knowledge how to breathe, run, walk, to climb and leap for practical purposes and self-preservation in accident. But I think we use them too much. We waste time and strength in not accomplishing the direct results of gymnastics, and fail to obtain the nerve stimulus that comes from natural play. If games and sports are organized and directed to a certain extent by the director of physical training, often, of course, the gymnastic and corrective value can be got out of a sport, and the fun, too."

Matthew Arnold, in his work on Higher Schools and Universities in Germany, says, in describing the exercise ground of a German school finely equipped for gymnastics, "Nothing, however, will make an ex-schoolboy of one of the great English schools

regard the gymnastics of a foreign school without a slight feeling of wonder and compassion, so much more animating and interesting do the games of his remembrance seem to him."

Statistics regarding the benefits that students have derived from athletic games are frequently asked for. These are difficult to state in the form of records. Nevertheless, the advantages are very real and very evident. A graduate of the University of California writes me, "Athletics proper, as distinguished from physical culture, are enormously important for girls—more so than for boys, for it brings out a side of their nature cramped from childhood." She says that, from her own experience, she knows that "there is nothing like the hard-played game to bring out powers of the body that the routine work can not touch. Still more, the mental and moral effect is wonderful. There is a zest, a freedom, a whole-souled sincerity of effort, a flinging aside of every consideration of how she is looking, or whether she is doing the proper thing, that goes right to the root of some of the most inveterate evils of feminine adolescence. The effect on our basket-ball girls has been perceptible in a single year; all their attitudes toward life have taken on a healthier and heartier tone." She adds that this is heartily the belief of the director of the gymnasium of the University of California.

The tendency of athletic games to dispel morbid conditions is, I think, too well known to require comment. One can not watch a game of basket-ball without observing the will-power, nerve-control, and general self-government which the rules of the game to prevent all rough play, and the necessity of quick decision and instant decided action, cultivate.

The match games give outdoor entertainment to the whole body of students, thoroughly diverting, and of the most healthful kind, free from all the unwholesome influences which more or less attend dramatics.

As a less direct result of the growing interest in athletics we may notice the increased stature of women, and a corrected æsthetic judgment which now pronounces the normal form the most beautiful.

A dinner was recently given at Vassar by one of the students, at which the guest qualification was the habitual wearing of broad-soled shoes. The hostess is a disciple of Matthew Arnold, who can not enjoy "sweetness and light" without a disposition to "make them prevail."

Many students ride the bicycle in all the colleges. So many papers have appeared in current literature setting forth the advantages of bicycling that little remains to be said on the subject. A note appeared in a September journal to the effect that at the annual sanitary conference at Newcastle, England, Dr. Turner

declared that cycling in England had raised the average health of women—and this of English women. It preaches more effectively the gospel of recreation, fun and fresh air, and of hygienic dressing, than could countless lectures of eminent physicians.

There is a problem which men have failed to solve and which confronts us—the problem of making general the habit and love of outdoor athletic sports. In spite of the interest awakened throughout the country in baseball, football, rowing, and track athletics, in spite of American successes in the international contests in Greece, it is yet true that American men are not, as a class, habitually athletic or physically vigorous.

So with our students: notwithstanding the interest that has been awakened in athletics among them, there are yet many whose outdoor exercise still consists in an hour's walk, which, allowing the mind to dwell on the last subject read, does but meager service as a form of physical recreation.

In this connection the question has arisen whether we shall endeavor to stimulate general interest in athletic games by intercollegiate contests. The Western colleges seem inclined to answer this question in the affirmative. Chicago has played with Northwestern; there has recently been a very interesting game between the University of California and Leland Stanford University, and other Western colleges are anticipating future competitions with neighboring institutions. On the other hand, the Eastern colleges unite in disapproving of intercollegiate contests. Among other reasons it is thought that the strain on the players would be too great; that the tendency would be to narrow rather than to increase the number of players by raising the standard of excellence of the play and discouraging the less expert players; also that the interclass contests afford all the advantages of intercollegiate games without the objectionable features of the latter.

In considering athletics for women we must reckon with the American's national characteristic of *immoderation* when fired by interest in any new thing. It will be necessary to restrain the enthusiastic few from excess while endeavoring to stimulate the indifferent many to active interest. The end to be desired is, of course, symmetrical development, not the training of athletes.

For the best solution of the problem to which I have referred I think we must look for help to the secondary schools, in the hope that physical training and instruction in hygiene may begin with them.

The freshman comes to college utterly ignorant of the fundamental laws of hygiene. It is exceptional when the physical examination does not reveal marked defects of the nature of weak backs, poor chests, round shoulders, and anæmia. She is un-

skilled and unpracticed in any athletic exercise, even in that of walking. After she has been in college a few weeks she will tell you, with great pride, that she has walked to town, a distance of two miles! Every claim upon her time at college, social as well as intellectual, outranks in importance the claims of exercise, and this duty yields to pressure from any other. If she were trained to rank study and play of the right kind as of equal importance to her mental development, the conscientiousness with which she devotes herself to study would secure her faithful attention to recreation.

It is encouraging to see that already some schools are setting the example of reform in this direction. One school at Indianapolis has introduced scientific physical training under a skilled director, and has placed this training on exactly the same footing as the intellectual exercises of the school. Besides gymnastics, daily outdoor exercise of two hours duration is required of each student.

In another school, in Connecticut, in the care of an English principal, there is no two-by-two daily promenade. Groups of not less than three girls are allowed, within certain bounds, to take a walk of from four to eight miles. In the hour and a half which they are required to spend in vigorous exercise out of doors, they play tennis, cricket, and basket-ball, occasionally having matches with other schools. In the winter physical training in the gymnasium is prescribed in connection with the winter sports of coasting and skating. A "high-stand" prize is offered, for which no girl is qualified to compete without a good athletic record for the year.

Of special importance to the student is the relation of athletics to the hygiene of the brain. Physicians say that if a muscle is once overtaxed or a nerve overstrained, they never regain their original tone and power; and yet I think that in America little care is taken to prevent such injury to the brain. We summarily dispose of its welfare with the classical platitude, "*Mens sana in sano corpore.*"

What is indicated by the fact that the college "valedictorian" of the past so many times sank into obscurity after his commencement oration, while his classmate, not overzealous in study and reasonably interested in athletics, subsequently rose to distinction at the bar or in the pulpit?—by the fact that the graduate student frequently fails to fulfill undergraduate promise and to go from strength to strength in mental achievement?—by the fact that the country youth with meager opportunities, fresh from simple rural life, so frequently outstrips classmates who have known all the advantages which our best schools can afford? What is indicated by these conditions but that the students of our schools

and colleges work in ignorance of the needs of the brain for its steadily strengthening development?

I was much interested to see in the October issue of the Popular Science Monthly a paper by Prof. Kraepelin, of Heidelberg, bearing on this point. His paper reports the result of experiments in "measuring the mental capacity of individuals." The measure is afforded by determining the number of small similar problems resolved by the subject in a given time—such, for example, as the continuous addition of a column of numbers. "Other means of measuring the capacity of a subject are afforded by the ease with which he is diverted from his task, or his susceptibility to disturbing influences from without and within; his elasticity, or the readiness with which he recovers from the effects of fatigue or diversion; and the way he is affected by taking food, physical exercise, and the time he has for sleep."

The experiment in addition, as made upon young men, showed that their *facility in addition fell off at the beginning of the second hour.* Experiments made by Prof. Burgerstein, of Vienna, showed that a *quarter of an hour of simple work is enough to develop the first signs of fatigue in a twelve-year-old pupil.*

Prof. Kraepelin claims that when fatigue "has once gained the upper hand, a speedy and unintermitted decline of efficiency ensues. The time when this shall take place depends on the degree of capacity already reached, the personal peculiarity, and casual influences."

It appears from these experiments that the mental vigor of most men is usually maintained at a certain height for the longest time in the forenoon. The rapidity with which one of the persons experimented upon could perform his tasks in addition sank about a third after a night journey by railway with insufficient sleep. Another experimenter could detect the effects of keeping himself awake all night in a gradual decrease in vigor lasting through four days.

The paper concludes as follows:

"When, now, we look back at the conditions we have discovered that control mental vigor, we conclude that our children are exposed by the extent and arrangement of study work in the schools to great perils for their mental and physical development. The questions that press upon us in this matter are of such importance that we all have reason to give them our full, undivided attention. We are only at the beginning of a real hygiene of mental labor, but the results we have obtained in this research, fully indicating the nature and operation of the dangers, point with equal clearness to the character of the preventive and remedial measures which should be sought and applied."

The president of one of our great universities has been quoted

as advising the following division of a student's day: Eight hours for sleep, ten for work, two for exercise, three for meals, and one for incidentals. Whether this is an authentic quotation or not, it describes with fair accuracy the practice of the average college girl, excepting that she rarely takes more than one hour of exercise. Her conscience is most approving when she spends all the time there is, apart from other definite engagements, with her books. Now, in the light of Prof. Kraepelin's experiments, if not in that of our own observation, what happens as the result of this protracted poring over books? Either injury is done to the brain through overexertion, or the brain protects itself by inattention and the student wastes precious time and depletes to no purpose her all too small store of vitality.

Prof. Kraepelin lays great stress on the importance of sleep as a compensation for all effects of mental fatigue, and all will agree with him in this. But he claims that "it is fundamentally false to regard physical effort as in any way a suitable preparation for mental labor. Protracted experiments pursued under my direction have given the result that a simple walk of from one to two hours diminishes the mental capacity in adults at least as much as about an hour's work in addition." How can we reconcile this with our own experience or with the testimony of students? Only a few days ago a student told me with enthusiasm of the ease and rapidity with which her evening tasks were accomplished after an afternoon during which she had walked two miles to town, had there taken a bicycle lesson of an hour, and then walked back to college, this being more than double her usual amount of exercise. Can there be any question as to which is the better preparation for a day of mental labor—nine hours of sleep and three hours of vigorous exercise in the open air, or twelve hours of sleep and no exercise? Of course, time should be allowed after vigorous physical exercise for the relaxation and rest of the muscles before using the brain, but the time required for this is not long.

It seems to me that the practice and experience of the English offer convincing testimony against Prof. Kraepelin's opinion on this point. An American student can not compete with the English student in respect to the amount of work done in a given time; nor, I am told, can the German student. The habits of Germans and Americans conform, and differ from the English in respect to long hours of work and short hours of exercise.

The English students have apparently learned that the brain does its best work when allowed long periods of leisure. They make strenuous efforts to reduce their hours of study to a minimum. They work on an average six hours a day. Students have taken honors at Cambridge with a smaller average of study

hours. I was told that Darwin achieved the work of his life by devoting three hours a day to his science. The dons at Newnham constantly urge the students to reduce their hours of work, claiming that the best results have been attained at the university by those who spent the least time in study.

The English students' power of concentration is remarkable. They respect perfectly the study hours of their friends, and will tolerate no interruption of their own. The English excel when tried by two of Prof. Kraepelin's tests of mental capacity: amount of work done in a given time and power of concentration.

Wherein lies their advantage? They will tell us that their strong and necessary ally is vigorous outdoor sport.

The English girl has, of course, known from childhood the habit of outdoor life. At college she plays hockey or hand polo, cricket, fives, and the games with which we are more familiar, for *at least* two hours a day, and oftener for a longer time. Two hours is a minimum of time spent in exercise. At frequent intervals, usually at the end of each week, she seeks recreation from past and preparation for future effort by spending many hours in the open air, in boating on the river it may be, or in taking a tramp of thirty miles or so. During vacations she not infrequently makes walking tours of longer or shorter duration.

If an English girl finds that her mind is inactive and unreceptive, she recognizes this as an indication that it needs recreation. She drops her books and puts her brain in fit condition for study by some vigorous play. Under like conditions, the American student, not recognizing Nature's signal, mentally scourges herself for dullness, and urges her jaded mind on to overexertion. I once heard an English girl assert that she could *dawdle* all day, but could not *study* for more than two hours at a time.

A senior at Vassar, who had been honored by her classmates with several appointments entailing strenuous editorial and executive duties, once said to me that she was grateful to the extra work for showing her in how short a time her regular work could be done. Having learned this lesson, she observed with surprise the time spent by her classmates over their tasks.

Every American who studies at Cambridge adopts the methods of work of her English friends, and ever afterward looks with compassion on the mistakes of her countrywomen.

The power of concentration of mind can not be exercised at will by those unaccustomed to practice it, but it can certainly be cultivated through training, and the earlier the training is begun the better. One school is known to me which has worked effectively in this direction by restricting the time spent in preparation of tasks, and by requiring a sufficient amount of outdoor play to keep the brain fresh and active.

In conclusion, we claim that the average American college girl, in comparison with her English cousin, expends by her methods of study a maximum of effort with a minimum of result; that, by way of reform, she should limit the hours of daily mental labor, as the workmen's hours of daily manual labor are limited, in order that during some periods of each day she may know perfect relaxation and freedom from pressing duties; that athletic games, instead of being for her a foe to scholarship, as the faculties of men's colleges seem inclined to regard them, may, by the exercise of good judgment in their use, be made an effective agent to build up the physique, and thus to keep the brain in condition for vigorous effort.

THE SCIENTIFIC WORK OF W. D. GUNNING.

By W. H. LARRABEE.

WHILE the applause and lasting fame which those win who make great scientific discoveries, or embody their observations in monumental books, are worthily bestowed, those also serve mankind and deserve to be well remembered who labor to make knowledge accessible to the whole people, and to lift the average of intelligence by writing books in plain language, by giving instruction, and by investing their teaching with the charms of their personal magnetism and warm eloquence. Of this latter class WILLIAM D. GUNNING was a conspicuous example. Few in the United States have labored more earnestly, with stricter singleness of purpose, or more successfully than he to interest the general public and make them acquainted with the latest results of true science.

Mr. Gunning was born in Bloomingburg, Fayette County, Ohio, July 28, 1828, and died in Greeley, Col., March 8, 1888. His family was of Scotch-Irish origin, but his direct ancestry is traced no further back than to Armagh, Ireland, whence his grandfather, William Gunning, emigrated in 1793 to Oswego County, N. Y., his father, Andrew Gunning, being then a child. The family removed to Bloomingburg in 1815. All that is told of the boy's early education is that he was taught at the log schoolhouse of his district by a young woman of the neighborhood. He showed an inquiring disposition and a tendency to bookish ways; and busied himself, it is said, with the stones and shells from the brookside near the house, and would ask to be told stories of them. When about fourteen years old he was apprenticed to Robert McLaughlin, his sister's husband, and was taught a trade. He always had a book on the bench by his side.

He developed a taste for discussion very early. He used to relate that it was a great treat to him, when a boy, to listen on Monday mornings to the remarks of the people of the neighborhood concerning the sermons of the Presbyterian minister of Bloomingburg. This minister was the Rev. William Dickey, who christened him, and after whom his second name was given

WILLIAM DICKEY GUNNING.

him. He had a great respect for him personally and as a preacher. But it is recorded of young Gunning that he refused to join the church, because he wished "to do his own thinking." He had a strong bent for theological studies, and would have dearly loved the office of pulpit teacher, but would not endure the restraints put upon thought by the theological schools, and

would never give up the privilege of honestly expressing his opinion. He declined several invitations to deliver addresses at Oberlin College, because his views were opposed to the beliefs held in that institution. But he finally consented to deliver the alumni address in 1879. He was never controversial, but simply and earnestly sought the truth. He entered Oberlin College about 1850, and was graduated from the literary department in 1854. Very soon after entering college he became a student of mark, and one of the few who, Mr. W. G. M. Stone, of Denver, a fellow-student in his last year, says, were "head and shoulders above their fellows, and himself second to none." The College Record of Deceased Alumni says of him that "when in college he was an enthusiastic cultivator of oratory and of a fine literary style. He had a marvelous command of words, a most fertile imagination, and was a skillful artist with crayon and chalk, so that his lectures were often enchanting as a dream. In his scientific facts he was accurate, but these were always subordinated to his philosophizing. He was an ardent devotee of the evolution theory. In religion he was of the liberal school."

After graduation he went to Natchez, Miss., where he had two brothers in business; taught in an academy; and studied law a year. His social relations there were all pleasant; but the independent Oberlin man, who in his boyhood had systematically aided fugitive slaves in escaping, could not make himself at home in the very center of the slaveholding region. Returning to Ohio, he exerted himself in behalf of the election of Mr. Chase, the Free-Soil candidate for Governor; and afterward engaged in geological work in Illinois, of which he kept no personal record. He took a course of comparative anatomy in New York, some time previous to 1862, but in what school or college is unknown, though he often bore testimony to the value of the instruction he received there.

Prof. Gunning's continuous career as a scientific author and lecturer began in 1862, and his earliest known publication was a paper on the Age of the Human Race, based on the discovery of relics of man in the caves of France, which was published in the Nevada (California) Journal. In the same year he was married and removed to Massachusetts; and about this time he began lecturing in and around Boston. He spent the summers, between the lecture seasons of several years, in physical and biological studies at Falmouth, Gay Head, Nantucket, Portland Harbor, and Eastport, a part of the time under the direction of Agassiz. Geology was the principal subject of his lectures, but as they went on they expanded till they covered a variety of subjects relating to life, evolution, American antiquities, and social theories. His

prime object in all his lectures was to elevate and enlarge the mental vision. He sought to present the truth as his studies had shown it to him in a manner to awaken the interest of his audience and make them informed upon the subject. He sunk himself in his theme, kept the question of money profit farthest from his thoughts, and was never known to relinquish a course because it did not pay. It would be impracticable to enumerate here the several subjects of these lectures or speak of the places in the East and West where they were delivered. The whole country knew him through them. They were given first chiefly in the Eastern States, then Chicago and the Northwest became the principal field, and in the later years of the author's life the Pacific and Southern States. They were delivered in public halls, before lyceums, in colleges, in the field, in churches, before Young Men's Christian Associations, and were nearly everywhere listened to with absorbed attention, and well received even by those whose views were very different from his, and were commended by the public, by scholars, and by men of science. Sometimes they met with opposition and hostile criticism, as at Brooklyn, N. Y., and at Keene, N. H., where the Young Men's Christian Association took pains to resolve that it would not be held responsible for his views. Darwinism had not yet ceased to be a novelty and a shock to theologians, and there were not wanting men who were ready to use any pretext for attacking him on this ground. He was never at a loss for a sufficient answer to these attacks, and simply relied on facts for the vindication of his position. The accounts given by the hearers of his lectures all speak of wonderful power in them—descriptive and persuasive.

He soon came into demand as a contributor to periodicals, and through the columns of such journals as The Congregationalist, Christian Union, Theodore Tilton's Golden Age, Lippincott's Magazine, etc., his articles reached tens of thousands of readers. While addressing common intelligence he would never trifle with his subject or "make a toy of science," and declined offers for papers on the "science-made-easy" plan. His purpose and the thought that animated him were well expressed in the preface to his Life History of our Planet—published in Chicago in 1876, with illustrations by Mrs. Mary Gunning, in the observation that teaching the facts of a science is not teaching the science; that "facts do not enlarge the mind unless they are fertilized by principles," and that he sought to conduct his reader "through method to results."

Visiting Europe in 1866, after the death of the first Mrs. Gunning, he made a pedestrian tour through Yorkshire; was a guest on geological excursions of Sir Thomas Crosley in Halifax; was entertained by Prof. Robert Harley; lectured at Huddersfield

and Brighouse, in England; then passing to the Continent, studied the Alps and their glaciers.

Being invited by Prof. E. L. Youmans to contribute to the first volume of the Popular Science Monthly, he wrote for it, after a special study on the spot, the article on The Past and Future of Niagara. This was followed by two other papers—Have Plants a Pedigree? and Progression and Retrogression.

As side incidents of Prof. Gunning's career, we may mention an experiment at orange cultivation in Florida, which, proving unprofitable, lasted but a short time; and services he rendered as a mining expert in the Western Territories.

As his religious views developed they became more and more radical. The independence of thought which he showed in youth when the subject of joining the church was mentioned was never relaxed; neither did the fervor of his religious feeling diminish. He appears through his whole career as a devout believer in the Creator and the spiritual life. He was much interested in the phenomena of spiritualism and impressed by them, wrote much upon the subject, and corresponded sympathetically with spiritualists. He was a member of the Free Religious Association and a valued contributor to The Index when Mr. Abbott and Mr. Underwood were its editors, and afterward to The Open Court, and a paper written by him in 1889 is believed to embody the earliest scientific treatment of the phenomena of that category. In 1887 he delivered a course of Sunday lectures to the Unitarian Society of Keokuk, Iowa. The military body of the city made him their chaplain. An Ethical Society was organized there, of which he served as pastor till January, 1888, when he removed to Greeley, Colorado, hoping to find relief there from frequently recurring attacks of bronchitis. He made an engagement with a Unitarian Society in Greeley, but two addresses—A Study of the Book of Job, and The Whirling Flag, Dante's Inferno—were all he was able to make in fulfillment of it. His health had long been delicate. A friend had warned him, in connection with his lectures in Cincinnati, in the winter of 1886, that he was "mad" to continue his labors in the existing condition of his health and in such weather. Yet he stopped, on his way from Keokuk to Greeley—only two months before he succumbed to his disease—to deliver a course of lectures in Quincy, Ill., which proved as acceptable as any of the long series. Of Prof. Gunning's amiable personal qualities all his friends speak in terms of warm enthusiasm. He was conscious, self-reliant, and tranquil to the last.

THE ANIMATE WORLD A UNITY.

By M. ALBERT GAUDRY.

THE aspect of paleontology has greatly changed since the time of Cuvier, when species were supposed to be fixed, and the curious monsters whose remains were unearthed from time to time were believed to be unchangeable, isolated entities. Now it is shown that fossil species are not thus independent, but are simply phases of development of types which are carrying on their evolution through the immensity of the ages. A plan has ruled in the vast and magnificent history of this evolution, and I purpose to tell what I believe I have discovered of it. I can not conceal that in the present state of science such an essay will be very imperfect. When I was traveling in the East I found the horizons in the morning veiled by the bluish mist which the poets are so fond of, and tried to discover the silhouettes of the beautiful marble mountains through them. So, in the morning of our paleontological science, we look upon the distances of life vaguely sketched, and try to distinguish a few lines of the plan that rules it. We discern but little, but that little is enough to charm us, as a glimpse of sunshine charms in a dark landscape.

It seems to me, further, that besides its philosophical interest, the inquiry into the plan of creation is of importance in practical geology. Up to this time the determination of the age of the earth has been empirical. It will become rational as soon as we are in possession of the plan of creation. Geologists will recognize that one of the best means of fixing the age of a formation is to know the stage of development of the fossils it contains.

The world of life is a grand unity, of which we can follow the development as we do that of an individual. When we follow the course of the immensity of geological times, we meet successive changes, and our mind goes on from surprise to surprise. Each epoch has its own physiognomy, and each phase of each epoch offers some variation; the days of the world follow one another and are not alike. Yet manifest as are the differences, they are not radical. Paleontology has not discovered any new branching or any new class or subclass.

From the primary ages, animated nature has had general traits of resemblance with existing nature. Sponges and polyps were already forming colonies, echinoderms were divided into five parts, insects were provided with three pairs of legs, arachnids had four, and myriapods had a multitude. M. Bernard Renault found in a coal bed an ostracode, the body of which is entirely preserved. A study of it made by M. Charles Brongniart showed the same details of organization as in our days. Numerous brachiopods

belonged to genera which exist in our seas—such as *Lingula*, *Rhynchonella*, and *Terebratula*. Besides fishes of special types, we find some with tendencies toward those of to-day. Prof. Vaillant, examining a Permian genus which I had described under the name of *Megopleuron*, thought it was so nearly like some living ceratodes of Australia that he proposed to describe it under the same generic name. The Primary reptiles, although very different from those of our epoch, have many characters of resemblance to them. For example, having occasion to study in detail the reptiles of the Permian, I was very much struck by seeing that their heads had the same bones, both above and below, as in the existing animals. MM. Marcellin, Boule, and Glangeaud, comparing the paws of a reptile of the same formation with those of a common *varanus*, remarked their extreme similitude.

When we come to the Secondary formations, we find many invertebrate animals related to living genera. Most of the vertebrate animals are easily distinguished from present genera, though usually not because they present any unknown special features, but because they combine characteristics that are now distributed among distinct classes. M. Seeley has recently described Triassic quadrupeds from Africa which diminish the distance between the reptiles and the mammals; the icthyosaurus, which is cited as one of the most extraordinary fossils, recalls the fish in its vertebræ, the massive mammals in its fore flippers, and the reptiles in its other characteristics. Although the pterodactyl certainly belongs to the class of reptiles, its manner of flying is like that of flying mammals. The iguanodon is a reptile with its hinder limbs forerunners of those of birds. On the other hand, the archæopteryx is a bird with reptilian recollections. The Secondary fossils, which have surprised paleontologists so much by their singular features, in reality establish connections among animated beings instead of disclosing gaps.

In the Tertiary epoch the existing genera—rhinoceros, tapir, boar, gazelle, elephant, hyena, cat, bear, etc.—appear each in its turn. We find species, as well as genera, so near living forms that it is difficult not to suppose their near relationship.

Finally, the species of Quaternary times are for the most part identical with those of to-day, or so little different that they may be considered simply as races. It is impossible to mark a boundary between beings that existed before us and those that live with us.

It must therefore be recognized that the fossil world is not distinct from the existing world; there is only a single world, which has continued from the most ancient ages till our days. It can be studied as if it were an individual; in the same way as we

follow the development of an individual through its different ages, we follow the development of the animate world through the phases of its existence that we call the geological ages.

When an old man feels the weight of years, he realizes indeed that his youth has departed from him; but at what moment did he pass from infancy to youth, and then to maturity and old age? He does not know; the phases of his life have unfolded themselves gradually. Things have gone in the same way for all beings. The world has not to-day the physiognomy it once had, but no one can say in what instant it passed from its Primary condition to its Secondary, and from that to its Tertiary, and then to its Quaternary and present. The change of beings has been slow and gradual.

The development of man—that is, of the individual himself—in which the marvels of the animate world are summarized, presents the following phases: 1. Multiplication of constituent parts—that is, numerous points of ossification appear which will become separate bones. 2. Differentiation of parts. As the parts multiply, they differentiate themselves; thus points of ossification similar in the beginning take on differences as they proceed; one becomes the humerus, another the radius, another the orbital bone, etc. 3. Growth of parts. At the same time that they multiply and differentiate themselves they are growing. 4. Progress of activity. Besides material progress, there is progress of a higher order—from the passive existence within his mother's womb till the individual reaches active life and manifests an energy of his own. 5. Progress of sensibility. Sensibility increases at the same time with activity, and sometimes determines it. 6. Progress of intelligence. Finally, intelligence appears. Last come, it also goes away last with sensibility, and will console the old man in the enfeeblement of his other faculties.

The history of the animate world, considered in the aggregate of geological times, is very similar to the history of a man in his brief life. We may study in succession the multiplication of beings on the surface of the globe; their differentiation; their growth; the progress of activity; the progress of sensibility; and the progress of intelligence.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE report of the British Association's committee on seismological observations recommends that, since it has been proved that any important earthquake is felt all over the globe, arrangements should be made for the record and study of these movements. Such records might prove as important as those of, for instance, terrestrial magnetism; and just as we have magnetic observatories in all parts of the world, so should there be seismological observatories.

CONDEMNATION OF CRIMINALS NOT PUNISHMENT.*

By EDWARD F. BRUSH, M. D.

WHEN studying a subject closely, we often discover that a simple word influences for right or wrong the whole matter, just as change of a note makes a different tune, or alters entirely the tone of the song. As Roget says: "A misapplied or misapprehended term is sufficient to give rise to fierce and interminable disputes; a misnomer has turned the tide of popular opinion; a verbal sophism has decided a party question; an artful watchword thrown among combustible material has kindled a flame of deadly warfare and changed the destiny of an empire." The word "punishment," as commonly used and understood judicially, should be eliminated from the tribunals that have to deal with that part of society that is known as the criminal class. Some one has said that jurists recognize only two terms in criminal law, "offense" and "punishment." The simplest and earliest definition of punishment is "to afflict with pain," and whenever the word is used it carries with it the idea or notion of consequent suffering. "There is undoubtedly a moral element in words; words are not neutral in the great conflict between good and evil, nor are there wanting, I suppose, in any language words that are the mournful record of the strange wickednesses which the genius of man, so fertile in evil, has invented." To the student of history does not the word punishment bring before the mind the cruel atrocities and horrible inflictions of the middle ages, with their gibbets, chains, racks, hot pincers, thumbscrews, and other hellish devices? It is a strange perversity of the human mind that many, very many words have deteriorated in their meaning; the word retaliation nowadays is never used to express a return of benefits, but always the paying of wrongs by wrongs; animosity, which was originally a very harmless word, is now used only to denote enmity and hate. I can recall no word that has taken the opposite course in our language, and the word punishment has now come by downward evolution from its original use to denote a spirit of vengeance, with its hatred, malice, and retribution, in the degraded sense of that word. Trench truthfully says: "There are often in words, contemplated singly, stores of passion as well as of historic truth; they are living powers, and quite as often and effectually embody facts of history or conviction of the moral common sense as of the imagination or passion of man; even as, so far as that moral sense may

* Presidential address delivered before the Society of Medical Jurisprudence at its annual meeting, held January 13, 1896.

be perverted, they will bear witness and keep a record of that perversion." The Pilgrims fled from England to escape the punishment of persecution, and soon they were themselves persecuting with dire punishment those whom they called witches, and also those who disagreed with them. Is it any wonder, therefore, that the Constitution of the United States should be marred by conferring the right to punish? When the truth of the axiom laid down by M. Ferri, in 1889, that "all men are responsible before society, but society has no right to punish, it has only the right to protect itself," is recognized as it surely will be, the instrument on which our liberties are built will not confer this pain-inflicting power, and the distinction between judgment and punishment will be clearly understood. That wise, wrinkled, and homely face of our martyred President masked a soul whose appreciation of the unchristian and debasing effect of public anger and vengeance was expressed when he uttered the immortal words, "Malice toward none, charity for all." To realize how the old ideas of punishment with its remorseless vindictiveness still possess the people, we have only to consider poor, trembling, unfortunate, irresponsible Guiteau, shambling his weary way from the court to the jail, when a human fiend, saturated with the barbarous notions of penalty and the spirit of vengeance inherited from past ages, fired at the helpless, unconvicted prisoner, and the awful echo of public exultation which followed his outrageous attempt. But this whole painful episode simply indicated a bitter spirit that will continue to dominate the people as long as the notion prevails that our courts of justice are to mete out retribution. Abolish the notion that society has the right to inflict pain, then the voice of the people calling for execution will be hushed. Eliminate from our courts the spirit of vengeance, and from the dire and sad necessity of taking human life remove the idea of punishment, implore God's pity alike on the executor and the executed, and human society will be kinder, better, and safer. When the idea of punishment is abolished, then the emotional attitude toward the criminal will disappear. None of the other dreadful, morbid conditions exhibited in the human being appear to elicit the kind of feeling we see very often demonstrated toward the very lowest murderer. When our courts of justice recognize that their functions are not to avenge, but to cure society of its diseased members, and that the treatment must be scientific, effectual, and humane, then the sentiments exhibited toward the criminal will be the same that we display toward the person afflicted with smallpox, typhoid fever, and the like. As organized society, we have the right to protect ourselves both against the unfortunate criminal and the unfortunate person afflicted with a contagious disease, but this right should not be deemed the right to

punish; no matter how grievous the methods we may adopt to prevent crime or other evils, we ought not to regard them in that light. It is very difficult to eliminate from the injured individual a feeling of anger and a desire for revenge, but our organized courts of justice should not by any word even appear to entertain or to strengthen such motives.

In the amputation of any portion of the body on account of gangrene or other morbid condition, there is no idea of punishment. The surgeons who are assembled in consultation to decide upon the treatment of the diseased member do not consider whether the morbid state is the result of transgression, but the simple question for them to decide is, "Will the other parts of the body be better if the diseased portion is removed?" All men of a scientific turn of mind who have made a study of criminal anthropology are fast approaching the physician's position regarding such questions. Every criminal is more or less a diseased portion of the body politic: some can be saved, some must be removed, and some must be destroyed, but the notion of punishment should not complicate the judgment in deciding what disposition is to be made in either case. The insane were formerly regarded with feelings of hatred and vindictiveness, but to-day this is only a shameful recollection. With the advance in the study of criminology and the more merciful era of humanitarianism that must follow, the like sentiments toward the criminal will be eliminated from our courts of justice. Prof. Austin Flint, the distinguished President of the New York State Medical Association, in his annual address to the association said, "Scientific progress will lead us finally to abandon the ancient idea of punishment of crime and substitute for it treatment and correction." Quetelet writes, "Every society has the criminals that it deserves."

There are very few persons who are not possessed by an intense desire to kill when they are suddenly confronted by a snake. Most of us have a hereditary prejudice against snakes, and can hardly talk about them without a shudder. Somewhat the same spirit possesses us when we hear of a murder: we are at once seized with a vengeful desire to hear of the murderer's capture and execution; but, as when, like reasonable human beings, we study the snake family, we find that there are differences among them, and some have qualities in consideration of which they might be spared, so with murderers—they are not all the same. The Hannigan trial is fresh in our memories; the motive that caused this man to commit a crime was the result of the very conditions which constitute our normal society; it was the deep sense of injured chastity, violated vows, a ruined life, broken home ties; this was made plain; the public demanded his release. Under the intense feeling engendered in society as to whether this man was to be

punished or not punished, the fact was lost to sight that he had disobeyed our social rules in not waiting for the courts to deal with the criminal whose life he took.

There are, roughly speaking, three elements in human society. The largest is always the standard, and is modified in character according to the conditions of the times. Of the two other elements that do not harmonize with this, the first is what is known as the criminal class. This is sometimes made up of a comparatively large number of individuals, and is in reality composed of members of the human race who are lagging behind in the advanced march of civilization. The other conflicting element is comparatively meager in numbers, and is characterized by its members being always in advance of the main body. They are variously called reformers, cranks, or heretics. Many of these two less numerous groups are often brought up to answer for their acts, and the ultimate aim of all judicial processes concerning them should be to make them members of the larger body. Where this is unattainable, the incorrigible should be either destroyed or removed permanently from the society with which they are in conflict. The whole history of criminology up to date indicates positively that punishment does not reclaim, and we must banish from criminal law all idea of vengeance as involved in the term. When we look at it as an isolated fact, the position of a judge trying to impose the exact punishment to fit the crime and weighing what he is pleased to call mitigating circumstances, in order to lessen the measure of wrath prescribed for some unfortunates who often as much need treatment as some of our insane, we must at once be conscious that there is something wrong in our judicial system. This idea has been deemed sufficiently ludicrous to form one of the telling points in a comic opera.

One of the principal elements impelling the criminal to crime is his desire to punish his enemy, for it can not be denied that a large number of murders are committed from this motive. Should the law that we term majestic proceed with the same motive toward the criminal? It will always appear to be so while we continue to speak of it in the language now used. If the spirit of anger and revenge could be entirely eliminated from the death penalty, and every idea of punishment meted out to an individual was removed from the judgment, only the absolute safety of society being made the reason for taking the human life judicially, executions would become exceedingly rare. It must be plain that the question for us to decide to-day is, Are we, who belong to the predominating class of society, bettered by our acts toward those who are not in harmony with the methods and motives that have made society what it is, and keep it in the position it now occupies; or are we debasing ourselves by our

method of dealing out punishment, as such, and thus keeping alive the spirit of vengeance?

What a ghastly, ludicrous state of affairs it must be, to see the murderer condemned to die, and awaiting in his cell the arrival of the fatal day, assured by his spiritual advisers that he has been pardoned by his Maker, and that the gentle Saviour is waiting to receive him in eternity, and still not have a ray of hope that the measure of the penalty, judicially pronounced, will be diminished! It would seem reasonable that a man who has been pardoned by his Creator should be pardoned by his fellows, and he surely should be if punishment was the only design. If, however, competent men have decided that his life is a menace to human society, then the questions of punishment and forgiveness are not to be considered. Even the great physician, Galen, seventeen hundred years ago wrote, "The evildoer is one whom we must destroy, not punish," repeating very nearly the words of Aristotle that when a criminal is a criminal by nature he ought to be destroyed, not in revenge, but for the same reason that scorpions and vipers are destroyed. Seneca advocated the same axiom. Let us, therefore, eliminate from our laws, which are or ought to be of benefit to humanity, all idea or notion of punishment; for, while our codes continue to present it, the whole aim and object of our common law, as it relates to the criminal, can not but point to the single fact of an effort to inflict pain on a human being. We try a man in order to ascertain if he must be punished, and the other higher, broader, and more noble function of the court, namely, to protect the majority of law-abiding citizens, is lost sight of by the larger proportion of the human race. The simple term justice or condemnation will convey the idea that the good of society is the consideration of the court, while the term punishment conveys the idea that the individual alone is the factor, and we can not blame the criminal, as long as it remains on our statute-books. for imagining that the whole force of our courts is to cause him bodily pain.

WHILE studying the songs of birds, Mr. Charles A. Witchell soon found that young birds acquire first the call cries and alarm notes of their respective species; that in each species these notes are much less liable to vary than are the songs; and that in different species physically allied they are more alike than are the songs of those species. Another interesting feature was the prominent occurrence of a particular cry in the species; its repetition in a less marked form in one or two allied birds, in which another cry might be the most pronounced; and the utterance of this second cry by some other allied birds, which had not the first-mentioned note. These facts are commended by the author to naturalists as bearing on the question of a common ancestry of species.

PLURAL STATES OF BEING.*

By ALFRED BINET.

THE variations of personality found in diseased subjects take on a great number of forms, of which the phenomenon resembling the presence of two or more personalities in the same individual—or "multiple personality"—is the subject of our present special study. It is common in hysteria, and the hysterical cases are those which have been most adequately investigated. These cases are often described as cases of somnambulism. In popular usage somnambulism is the state of those who rise in the night and perform automatic and even intelligent acts without waking. They dress themselves, perhaps, resume their day's work, solve a problem to which they had vainly sought the solution before, then return to bed and to sleep again; the next morning they have no memory of having been up in the night. Indeed, they are often much surprised to see a piece of work now finished which had been unfinished the evening before. Or they walk on the roof or perform some other equally startling feat. Authors are not as yet entirely agreed upon the nature of this sleep-walking, but the general tendency of the day is to admit that it covers a mass of irregular phenomena which resemble one another in appearance only, being really quite distinct in nature. In these phenomena we may see an example of double personality. These noctambulists are two persons. The person who rises in the night is entirely distinct from the one who is awake during the day, since the latter has no knowledge or memory of anything that has happened during the night. But it is not possible to make an adequate analysis of this state; the elements are too obscure.

Another form of natural somnambulism is "daytime" somnambulism, or vigilambulism, and concerns hysterical patients who possess, besides their normal and regular life, another psychological existence or second state, so to speak, of which they retain no memory in their normal condition. The peculiar characteristic of this second state is that it constitutes a complete psychological existence; the subject lives the everyday life, his mind is alive to all ideas and perceptions, and he is not delirious. Uninformed persons would never know that the subject is in a state of somnambulism.

The best examples that can be cited of the somnambulism that

---

* From Alterations of Personality. By Alfred Binet. Translated by Helen Green Baldwin, with Notes and a Preface by J. Mark Baldwin. (International Scientific Series.) In press of D. Appleton & Co.

we have just defined are found in observations, now old, made by Azam, Dufay, and other physicians. These observations are to-day well known and trite. They have been published and analyzed in a number of medical journals, and even in some literary ones.

The state of somnambulism is artificially induced in hypnotism, which may be brought about in a large variety of ways, in all of which there are reasons for supposing the psychological causes play the larger part. When one now comes to define somnambulism from the psychological point of view he sees at once that it constitutes a new mode of mental existence. The old mesmerists were quite right when they described it as a second personality.

Two fundamental elements constitute personality—memory and character. In the latter respect, as to character, induced somnambulism is not perhaps always clearly distinguishable from the waking state. It frequently happens that the somnambulist does not relinquish the character that he had before he was put to sleep. The reasons are manifold. This does not, however, hold for the second element of personality—memory. It has long been said that memory supplies the chief sign by which the new state may be distinguished from the normal state. The somnambulist shows, in fact, a curious modification in the range of his memory; the same regular phenomena of amnesia may be produced in him as occur in the spontaneous variations of personality.

Two propositions sum up the principal modifications of memory which accompany induced hypnotic somnambulism; first, the subject recalls during his waking state none of the events which happened during somnambulism; and second, on the other hand, when put in the somnambulistic state he may remember not only the previous somnambulistic states, but also events belonging to his waking state. It follows that memory attains its maximum extent in somnambulism, since it then embraces two psychological existences at once, as the normal memory never does. It may even be remarked that the somnambulist, when he endeavors to recollect certain particulars, has better memory than the same person awake. Gurney has shown, moreover, from studies of hysterical patients, that somnambulistic states may persist in the waking life; that the somnambulistic ego, the second condition, is not always completely effaced when the waking state returns, but survives, coexists with normal thought, and gives rise to complex phenomena of division of consciousness.

A second form of the phenomenon of double personality is the coexistence of the two egos, which is presented in two cases. The

first is hysterical insensibility. If a part of a person's body is insensible, he is not aware of what happens to it; and, on the other hand, the nervous centers in relation with this insensible region may continue to act, as is the case in hysteria. The result is that certain actions, more often simple, but sometimes very complicated, can be performed subconsciously by a hysterical patient; further, these actions may have a psychical nature, and show intellectual processes distinct from those of the subject, thus constituting a second ego, which coexists with the first.

A second condition that may occasion the division of consciousness is the concentration of attention on a single thing. The result of this state of concentration is that the mind is absorbed to the exclusion of other things, and to such a degree insensible that the way is opened for automatic actions; and these actions, becoming more complicated, as in the preceding case, may assume a psychical nature and establish intelligences of a parasitic kind, existing side by side with the normal personality, which is not aware of them.

The real nature of hysterical anæsthesia has long been misapprehended, and it has been compared to common anæsthesia from organic causes, as, for example, from the interruption of the afferent nerve tracts. This way of considering it should be completely abandoned, for we now know that hysterical anæsthesia is not a real local insensibility, but an insensibility due to unconsciousness, to mental disintegration; in short, it is psychical insensibility, arising simply because the personality of the patient is impaired, or even entirely divided.

The existence of unconscious phenomena in the case of hysterical patients need not astonish us, for each one of us may, if we watch ourselves with sufficient care, detect in ourselves a series of automatic actions, performed involuntarily and unconsciously. To walk, to sit down, to turn the page of a book—these are actions which we perform without thinking of them. But it is difficult to study unconscious activity in a normal man, for this activity shows itself chiefly in routine, in formed habits, kept going by repetition; in general, it does little new. Sometimes it seems to judge and reason, but these are old judgments and reasons which it repeats. At all events, it seldom acquires any considerable development, and almost never, one might say, amounts to the dignity of an independent personality. The conditions of study are much more favorable when we apply ourselves to hysterical subjects.

Among these unconscious phenomena are those known as movements of repetition, and these are often provoked by suggestion—as when an order or suggestion is given to a person awake or in a somnambulistic state to imitate all movements that are

performed before him, or to continue indefinitely the regular movement that is imparted to a part of his body. It is supposed, for the explanation of this phenomenon, that the continuation of a movement may occur, either from obedience or merely because an image has been conjured up in the mind of the patient, this image being the source of the movements. An anæsthetic hand is made to write a letter; the movement of this hand stimulates somewhere in the mind of the unconscious subject the motor images; these images are not inhibited by anything; they spend themselves in action, and the movement is repeated. This involves no obedience; it is a much more simple and elementary psychological phenomenon. These explanations may possibly both hold good, each for different persons and for different conditions of experiments.

The same effects as in anæsthesia may be produced in the state of distraction. Attention—an effort of the mind and of the entire organism which increases the intensity of certain states of consciousness—if brought to bear on a perception, makes it more swift, more exact, more detailed. This adaptation of all the available force of the organism converging in a single event, which may be a sensation, an image, a sentiment, etc., produces a temporary state of monöideism. It is accompanied by distraction. One can not pay attention to certain things without being distracted from others. The likeness of distraction and anæsthesia has been mentioned. A hysterical patient whose arm is insensible finds himself in very nearly the same state of mind as if he never thought of his arm, or if he were indifferent to it, or as if he had concentrated the power of his attention on other things. So we may try experiment with it: we may concentrate this hysterical patient's attention on a certain point and examine the special effects of the division of consciousness produced by distraction. The ease with which the attention of these patients can be distracted is almost incredible. Profiting by the state produced, one has only to approach from behind and pronounce some words in a low voice to place himself in relation with the unconscious person. The sentence is not heard by the principal personality, whose mind is elsewhere, but the unconscious person hears it and acts upon it. The identity of the secondary ego constituted during anæsthesia or distraction with the somnambulistic ego has been established in experiments by M. Paul Janet.

While the two consciousnesses are separate from a certain point of view, they may be reunited from another point of view and may retain both relations. The phenomena are very complicated and very interesting for psychology. The relations of two consciousnesses may take two distinct forms—those of antagonism and those of united action. When they are in collaboration we

have the two fundamental facts of the representation of the movement before it is performed and the perception of the movement as it is performed, or the model and the copy states of consciousness. These are illustrated in a remarkable way in automatic handwriting or the performance of graphic movements which are unknown to the principal consciousness and in a great variety of other movements which are brought about in the secondary consciousness by sensations, ideas, and states of all kinds which may occur in the principal consciousness. A curious manifestation of this reunion of consciousnesses is that of suggestions from unconscious indications, as when the infliction of a certain number of pricks on an unconscious member gives rise to a suggestion of the number, or when the pressure of a coin or other design suggests a rude reproduction of the design more exact in detail than is made when the organism is in the normal condition. The connections of these consciousnesses are in fact capable of producing hallucinations of all the senses, fixed ideas, and emotional effects.

Among experiments cited in which the person is induced to perform unconscious movements is that of the exploring pendulum described by Chevreul, the oscillations of which depend on psychological movements in the mind of the performer of the experiment, it registering the unconscious movements of the hand and making them perceptible by increasing them. Automatic handwriting is a psychological action of a similar nature, but a little more delicate and more complex.

What are called unconscious movements of healthy subjects and the various reactions of the secondary personalities of hysterical patients are really identical, but differ in extent, in external circumstance, or in degree of development; and healthy subjects may present special conditions of mind that tend to bring on mental disintegration, as when attention is divided among a great many subjects or when it is intensely concentrated on one thing and distracted as to all others; but the unconsciousness thus produced does not reach the degree of development attained in hysterical persons and is not as brilliant. It will not spontaneously write letters and confessions, but is still something positively existing.

Recent researches have thrown new light upon phenomena of spiritism, or so-called "spiritualism," by showing that these phenomena are due largely to mental disaggregation or division. There is no essential difference between the experiments described upon hysterical patients and the more spontaneous experiments that the spiritists practice upon themselves. The principal differences lie in the minor, or, one might almost say, anecdotal conditions—i. e., in the medium, the terms employed, or the imagined explanations.

SKETCH OF MARIA MITCHELL.

THE list of the great inscribed on the Boston Public Library bears the name of one American woman—Maria Mitchell. While other names of women equally worthy to be recorded there may easily occur to all of us, the validity of Miss Mitchell's title to be thus remembered will not be doubted.

MARIA MITCHELL was born on the island of Nantucket, August 1, 1818, and died in Lynn, Mass., June 28, 1889. Her parents belonged to the Society of Friends, of the colony who settled in Nantucket when that island belonged to New York; the father a school teacher and afterward cashier of a bank, indulgent to his children, fond of animals and kind to them, and cultivating a well-developed taste for experimental astronomy. He was also fond of beauty and of enjoyable things, and, as the rules of the society would not allow him to wear bright colors, he indulged his taste for them by buying red-covered copies of books, painting the framework of his telescope bright red, spreading a gay carpet on the floor, papering his sitting room with pink rose designs, and displaying the polarization of light. The mother was a woman of strong character, clear-headed and demonstrative. Books were abundant, in the house and at the library. Mr. Mitchell from his early youth was an enthusiastic student of astronomy. The evenings when pleasant, Mrs. Phœbe M. Kendall says in her biography, "were spent in observing the heavens, and to the children, accustomed to seeing such observations going on, the important study in the world seemed to be astronomy. One by one, as they became old enough, they were drafted into the service of counting seconds by the chronometer during the observations. Some of them took an interest in the thing itself, and others considered it rather stupid work; but they all took in so much of this atmosphere that, if any one had asked a little child of this family, 'Who was the greatest man that ever lived?' the answer would have come promptly, 'Herschel.'" Maria very early learned to use the sextant. On the occasion of the annular eclipse of the sun of 1831—central at Nantucket—when she was twelve years old, she held the chronometer, counting the seconds, while her father observed the eclipse. This event was called up in her diary, March 16, 1885, when she wrote, mentioning it, that now, "fifty-four years later, I counted seconds for a class of students at Vassar; it was the same eclipse, but the sun was only about half covered. Both days were perfectly clear and cold." At sixteen she became an assistant teacher in the school of Mr. Cyrus Peirce, where she had been a pupil; afterward opened a private school; and then became, for twenty years, librarian of the Nan-

tucket Athenæum. In the library she found Dr. Bowditch's translation of La Place's *Mécanique céleste* and Gauss's *Theoria Motus*, in Latin, and read them. She also read voraciously on all subjects; and, as librarian, saw that the boys and girls got good books, while she skillfully kept the unwholesome ones out of their sight. While enjoying in her home all advantages for the cultivation of her scientific tastes, Miss Mitchell took her part in all the household work, knew how everything was to be done, and did what she did thoroughly. On one occasion, when the "help" had gone, she took charge, and made a record of how she spent the day. It was late in October. She arose at six, having been half asleep only for some hours, fearing she might not be up in time to get breakfast. "It was but half light, and I made a hasty toilet. I made a fire very quickly, prepared the coffee, baked the Graham bread, toasted white bread, trimmed the solar lamp, and made another fire in the dining room before seven o'clock. . . . I really found an hour too long for all this, and when I rang the bell at seven for breakfast, I had been waiting fifteen minutes for the clock to strike. I went to the Athenæum at 9.30, and, having decided that I would take the Newark and Cambridge places of the comet and work them up, did so, getting to the three equations before I went home to dinner at 12.30. I omitted the corrections for parallax and aberration, not intending to get more than a rough approximation. I find to my sorrow that they do not agree with those from my own observations. I shall look them over again next week. At noon I ran around and did several errands, dined, and was back again at my post by 1.30. Then I looked over my morning's work—I can find no mistake. I have worn myself thin trying to find out about this comet, and I know very little now in the matter. I saw, in looking over Cooper, elements of a comet of 1825 which resemble what I get out for this from my own observations, but I can not rely upon my own. I saw also to-day in Monthly Notices a plan for measuring the light of stars by degrees of illumination—an idea which occurred to me long ago, but which I have not practiced." The next day she got breakfast again, and varied her astronomical computation with tatting, reading in Humboldt's Cosmos for rest when she was tired; and in the evening, it being stormy and no observing, made a loaf of bread, worked at tatting and gave a lesson in it, and completed sixteen hours of steady work.

The discovery of a comet by Miss Mitchell, which first made her known to the world as an astronomer, is thus described in Mrs. Kendall's Life, Letters, and Journals: "Miss Mitchell spent every clear evening on the housetop 'sweeping' the heavens. No matter how many guests there might be in the parlor, Miss Mitchell would slip out, don her regimentals, as she called them,

and, lantern in hand, mount to the roof. On the evening of October 1, 1847, there was a party of invited guests at the Mitchell home. As usual, Maria slipped out, ran up to the telescope, and soon returned and told her father that she thought she saw a comet. Mr. Mitchell hurried upstairs, stationed himself at the telescope, and, as soon as he looked at the object pointed out by his daughter, declared it to be a comet. Miss Mitchell, with her usual caution, advised him to say nothing about it until they had observed it long enough to be tolerably sure. But Mr. Mitchell immediately wrote to Prof. Bond, of Cambridge, announcing the discovery. On account of stormy weather, the mails did not leave Nantucket until October 3d." The comet was seen by Father de Vico at Rome, October 3d, and word of it was immediately sent to Prof. Schumacher at Altoona; by Mr. W. R. Dawes in Kent, England, October 7th; and by Madame Rümker at Hamburg, October 11th. The priority of Miss Mitchell's discovery was generally acknowledged. The King of Denmark had offered a gold medal to the first discoverer of a telescopic comet, but, dying, was succeeded by a king not so much interested in astronomy. Miss Mitchell, moreover, failed in securing priority of registry of the discovery, according to the terms laid down in the king's offer—a thing that was impossible in those days before the Atlantic telegraph. Her claim was taken up and pressed by Edward Everett, and referred by the king to Prof. Schumacher, who reported in favor of granting the medal to her. A few months after this, in 1848, Miss Mitchell was unanimously elected an honorary member of the American Academy of Arts and Sciences, being the first and only woman ever admitted to that society. She afterward became a member of the American Institute and of the American Association for the Advancement of Science. Of the meeting of this body in Boston in 1855, she wrote: "It is really amusing to find one's self lionized in a city where one has visited quietly for years. . . . For a few days science reigns supreme—we are fêted and complimented to the top of our heart, and although complimenters and complimented must feel that it is only a sort of theatrical performance for a few days and over, one does enjoy acting the part of greatness for a while!" In 1849 Miss Mitchell, on the invitation of the late Admiral Davis, undertook the computations, for the Nautical Almanac, of the tables of the planet Venus—a work which she carried on, in addition to other duties, for nineteen years. In the same year she was employed by Prof. Bache, of the United States Coast Survey, in the work of an astronomical party at Mount Independence, Maine.

In 1854 she records her "sweeping" of the heavens—a kind of work she really enjoyed, though her back soon became tired before the cold chilled her; in March, seeing two nebulæ in Leo

with which she was not familiar and which repaid her for her time; and on September 18th, observing the two nebulæ in Ursa Major, which she had known "for many a year," but which to her surprise now appeared to be three. "The bright part of this object was clearly the old nebula, but what was the appendage? Had the nebula suddenly changed? Was it a comet, or was it merely a very fine night? Father decided at once for the comet; I hesitated, with my usual cowardice, and forbade his giving it a notice in the newspaper." Flying clouds prevented more satisfactory observations that evening and the next two, but "on the 21st came a circular, and behold Mr. Van Arsdale had seen it on the 13th, but had not been sure of it until the 15th on account of the clouds. I was too well pleased with having really made the discovery to care because I was not the first. Let the Dutchman have the reward of his sturdier frame and steadier nerves!" She consoled herself, further, by reflecting that the 13th was cloudy, and that she had evaded the task of making the computations, which she would have had to do to call the discovery hers. She seems, however, to have tried her hand at the computations, and was despondent because she had to renounce her own observations as too rough for use. "The best that can be said of my life so far is that it has been industrious, and the best that can be said of me is that I have not pretended to be what I was not."

The diary for 1857 tells of an extensive tour through the South, the many striking incidents of which are recorded with keen humor, and the first journey in Europe, in which Miss Mitchell took her almanac work with her.

On this her first visit to Europe, in 1857–'58, Miss Mitchell took letters from eminent scientific men in the United States to distinguished astronomers and mathematicians, and other persons, abroad. She was cordially received, and the astronomers opened their observatories to her and entertained her at their homes. To mention the names of all the notable persons whose acquaintance she thus made would be like making a list of the men of the time distinguished in science, literature, and art. Her observations, very freely given in her private journal but always kindly, contain much about the instruments and furnishings of the scientific establishments and the methods of carrying on the work. She found Mr. Airy, at Greenwich, not favorable to the multiplication of observatories; and to his remark that he would gladly destroy one half of the meridian instruments of the world by way of reform, she replied that her reform movement would be to bring together the astronomers who had no instruments and the instruments which had no astronomers. At Greenwich she met Herr Struve, the famous astronomer of Pulkova, visiting England on a scientific mission—"a magnificent-looking fellow, very large

and well proportioned; his great head is covered with white hair, his features are regular and handsome. When he is introduced to any one he thrusts both hands into the pockets of his pantaloons, and bows"; and he told her that it was not necessary for her to present her letters—he knew her without.

With the Airys she went to Cambridge and visited Whewell, of whom—"An Englishman is proud, a Cambridge man is the proudest of Englishmen, and Dr. Whewell the proudest of Cambridge men." He was very severe, even to discourtesy, on Americans, and imperious in manner; and escorted Miss Mitchell to church wearing "a long gown reaching nearly to his feet, of rich scarlet, and adorned with flowing ribbons," which did not match the robe but were nearly crimson. At Cambridge she met Mr. Adams, the English calculator of the place of Neptune, and Prof. Sedgwick, then an old man of seventy-four. She was cordially entertained by Sir John and Lady Herschel; visited Le Verrier at his home in Paris; and at Rome was called upon by Father Secchi, and was admitted to the observatory where Mrs. Somerville and the daughter of Sir John Herschel had been refused; that observatory for which the Papal Government furnishes nice machinery to keep the telescope accurately up with the motion of the earth on its axis; "the same motion for declaring whose existence Galileo suffered; the two hundred years have done their work." At Florence she called on Mrs. Somerville, who, though seventy-seven years old, looked twenty years younger and came tripping into the room, speaking at once with all the vivacity of a young person, was interested in every new improvement, as much at home in the drawing room as in science, and asked many questions in regard to the progress of science in America. At Berlin she saw Humboldt, who was much obliged to her for calling to see him, talked intelligently to her about current affairs in the United States, told her the latest news from home, and showed her Clinton, N. Y., on the map when she did not know where it was.

A few months after the death of Mrs. Mitchell, in 1861, the family removed to Lynn, Mass., where Miss Mitchell had bought property, to which she transferred her observatory, and where she remained until she was called, in 1865, to be Professor of Astronomy and Director of the Observatory at Vassar College. This involved a change of occupation, and one that would, to a certain extent, divert her attention from what had been her life-work of observing. "But she was so much interested in the movement for the higher education of women, an interest which deepened as her work went on, that she gave up in a measure her scientific life, and threw herself heart and soul into this work." She further, in the course of time, gave up her work on the Nau-

tical Almanac, in order to devote herself more exclusively to this. In October, 1888, we find this entry in her diary: "Resolved, in case of my outliving father and being in good health, to give my efforts to the intellectual culture of women, without regard to salary; if possible, connect myself with liberal Christian institutions—believing, as I do, that happiness and growth in this life are best promoted by them, and that what is good in this life is good in any life." She had her own views about the way teaching should be done, and did not hesitate to express them. Thus: "Our faculty meetings always try me in this respect; we do things that other colleges have done before. We wait and ask for precedent. If the earth had waited for a precedent, it would never have turned on its axis!" She thought teachers were inclined to talk too much; that to read a book, to think it over, and to write out notes, was a useful exercise; that "the greatest object in educating is to give the right habit of study; . . . not too much mechanical apparatus, let the imagination have some play; a cube may be shown by a model, but let the drawing upon the blackboard represent the cube, and, if possible, let Nature be the blackboard; spread your triangles upon land and sky; . . . a small apparatus well used does wonders. . . . I find a helping hand lifts the girl as crutches do; she learns to like the help which is not self-help." The relation between herself and her pupils is described as having been very cordial and intimate, and she remarked to one of her classes entering upon its study for the last year, "We are women studying together." According to her own description of her teaching, her beginning class used a small portable equatorial, which stood out of doors from seven o'clock in the morning till nine o'clock in the evening. They were expected to determine the rotation of the sun upon its axis by watching the spots; "the same for the planet Jupiter." They determined the revolution of Titan by watching its motions, the retrograde and direct motion of the planets among the stars, the position of the sun with reference to its setting in winter and summer, and the phases of Venus. "All their book learning in astronomy should be mathematical. The astronomy which is not mathematical, in what is so ludicrously called 'geography of the heavens,' is not astronomy at all." The senior girls in practical astronomy were taught separately: to obtain the time for the college by the meridian passage of stars; to find a planet at any hour of the day; to make drawings of what they see, and to determine positions of planets and satellites; to determine differences of right ascension; to know the satellites of Saturn by their physiognomy, as if they were persons; and they sometimes measured diameters. She held the marking system in contempt, would not drill, and could not drive.

Miss Mitchell began to observe the various colors of the stars in 1853, but nothing in her remarks concerning the phenomenon indicates that she had any anticipation of the explanations which later astronomers have offered for it. Her appreciation of it was largely æsthetic, but, as Mr. Bishop had found the blue stars generally small, she thought we might assume "that the blue stars are faint ones, and probably distant ones. But as not all faint stars or distant ones are blue, it shows that there is a real difference. . . . From age to age the colors of some of the prominent stars have certainly changed. This would seem more likely to be from change of place than of physical constitution. Nothing comes out more clearly in astronomical observations than the immense activity of the universe. 'All change, no loss, 'tis revolution all.'" Then she was led to remark that all observations of this kind are peculiarly adapted to women. "Indeed, all astronomical observing seems to be so fitted. The training of a girl fits her for delicate work. The touch of her fingers upon the delicate screws of an astronomical instrument might become wonderfully accurate in results; a woman's eyes are trained to nicety of color. . . . Then comes in the girl's habit of patient and quiet work, peculiarly fitted to routine observations. The girl who can stitch from morning to night would find two or three hours in the observatory a relief."

The chief scientific incident recorded of Miss Mitchell's second European tour (1873) is her visit to the observatory at Pulkova, where the second Struve—Otto—was director. Her Russian journal contains some keen comparative observations concerning civilization and education in Russia and the United States, not always to the advantage of the United States.

In 1859 Miss Mitchell was presented by the republic of San Marino with the bronze medal of merit, with the ribbon and letters patent signed by the two captains regent. In August, 1869, she went with several of her Vassar students to Burlington, Iowa, to observe the total eclipse of the sun, and published a popular article on the subject in the magazine Hours at Home. Her scientific record of the observation was published in Prof. Coffin's report. In 1878 she went to Denver to observe the eclipse. Her observing party of five ladies besides herself had their special places at the three telescopes as counters or as artists, and made the observations in silence. "Great," she says, "is the self-denial of those who follow science. Those who look through telescopes at the time of a total eclipse are martyrs; they severely deny themselves. The persons who can say that they have seen a total eclipse of the sun are those who rely upon their eyes. My aids, who touched no glasses, had a season of rare enjoyment."

In June, 1881, while going to Providence in a steamboat, she

caught her first view of a new comet from the stateroom window. She at once hurried back to Poughkeepsie to make her observations. An apple tree was in the way, and she had it cut down. Then a mist arose, and the observation had to be postponed. On account of the incident of the tree, the girls called her George Washington.

During her later years at Vassar, Miss Mitchell endeavored to raise a fund to endow the chair of astronomy. The fund was completed after her death, amounting to fifty thousand dollars, and is known as the Maria Mitchell Endowment Fund. It was her custom every year, in the week before commencement, to give her students a "dome party"—a breakfast— in the observatory, and these were most enjoyable occasions to all.

Miss Mitchell was chairman of the Standing Committee on Woman's Work in Science of the American Association for the Advancement of Women, and was for several years president of the association. "Some of her students did their first work for women's organizations in gathering statistics and filling out blanks which she distributed among them." She believed in the woman suffrage movement, but took no prominent part in it. She was the first woman elected to membership in the American Academy of Arts and Sciences, Boston. She was chosen in 1859 a member of the American Philosophical Society; was for many years a member of the American Association for the Advancement of Science; was connected with the New England Women's Club and with Sorosis; and received degrees from Rutgers Female College, Hanover College, and Columbia College. She contributed a paper on Mary Somerville to the Atlantic Monthly in 1860; articles, mostly on observations of Jupiter and Saturn, to the American Journal of Science; a few popular science papers in Hours at Home; and an article on The Herschels was printed in The Century just after her death. She also read a few lectures to small societies and to one or two girls' schools, "but she never allowed such outside work to interfere with her duties at Vassar College." She resigned her position in Vassar College, on account of growing infirmity, in January, 1888, after having, as she boasted, earned a salary, without any intermission, for more than fifty years. The trustees made her professor emeritus, and offered her a home in the observatory, but she preferred to spend the few remaining months of her life with her family in Lynn.

It is partly a result of Miss Mitchell's work that woman astronomers are now no longer regarded as something remarkable.

Editor's Table.

POLITICS AND MORALS.

IN many States of the Union the school laws provide for compulsory education in what is called "temperance." How far the education supplied under this head sometimes is from being based on strict scientific principles was well shown some time ago by an able contributor to this magazine. It is a question, however, whether if even the instruction in "temperance" was all it ought to be from a scientific point of view, it is as much needed as other instruction for which no legal provision is made; we mean especially instruction in the everyday duties of citizenship.

According to prevalent ideas in this country, a people is free when it has adopted a popular form of government, and done away with everything having the appearance or savor of monarchy or aristocracy. Thus the Venezuelans are to be considered a free people because their government is, in form, republican; and the inhabitants of British Guiana not free, or at least not so free, because they are connected with the monarchy of Great Britain. In the early stages of the Venezuelan difficulty we heard not a little about the American system of government and American political ideas as opposed to the European system and European ideas. In the imagination of many, Venezuela stood for freedom and England for tyranny; and the interests of civilization were held to demand that the free power should be strengthened and the power representative of tyranny checked. To be sure, there was a country to the north of us, also connected with the British Empire, in which a reasonable degree of freedom seemed to exist. Still, that was not the right way of being free; the right way was to have your government republican in name as well as in essence, and above all to enjoy the vicissitudes of periodical elections for the chief magistracy. This Venezuela had done, and therefore Venezuela was a true home of orthodox freedom.

Happily, the Venezuelan difficulty is a difficulty no more as between the United States and England; but the underlying political ideas which tended to embitter feeling, and did so dangerously embitter it, on this side are deserving of study. Why has the overthrow of autocratic government provoked so much popular enthusiasm from the days of Harmodius and Aristogeiton down to our own times? Because the autocrat has been conceived of —and often rightly—as a man who used his power for his own selfish ends. The tyrant of popular imagination is a man who takes the taxes of the poor to spend upon his luxuries and vices; and the tyrant in history has not infrequently filled precisely this unworthy rôle. The advantage, then, to be gained from dethroning tyrants is that the power and resources of government then become available for the uses of the state. A virtuous tyrant would be one who used all his power in an unselfish manner for the benefit of his subjects; but when in the course of events even the virtuous tyrant becomes an impossibility, what is to be done with the power he formerly exercised? It passes over to the people; now what is going to be done with it? Here we come to the

true *crux* and crisis of modern republican institutions. Strictly speaking, the power that has been wrested from the monarch ought to be applied, as a good monarch would apply it, to the benefit of the state as a whole; but how is it really applied?

Here it is, as we conceive, that there is room for a teaching, to speak plainly, of far greater value and importance than that which the law prescribes in the interest of "temperance"; the teaching, to wit, that political power can be as much abused, and in multitudes of cases is as much abused, by the individual citizen as by any autocrat that ever lived. What can the autocrat do worse than use the power which he has grasped, or which has descended to him, for personal purposes instead of for public purposes? It is true he uses *a great deal of power*, and thus is in the way of doing a great deal of harm; but in essence he does no worse than the citizen who sells his vote or makes any use of it other than that which consideration of the public good would prescribe. The individual citizen wields but a fractional part of the power of the autocrat; but the part he wields does not belong to him as his personal property; and, if he uses it as such, he is simply a tyrant on a small scale, or, say, a fractional tyrant instead of an integral one. He is doing with his little bit of power just what the other man did with his vast and concentrated power. In fact, he is doing worse, because if he abuses his vote and influence he abuses *all* he possesses, whereas no autocrat was ever yet so bad that part of his power was not exercised for the public good. Tiberius and Nero were execrable men, but many of their public acts were directed to the good of the state. The idea, therefore, which it is important to get into the mind of the young is that *the irresponsible voter is a tyrant*: he is diverting to private purposes a measure of political power which only belongs to him for public purposes.

Then, just as in "temperance" education the evils of intemperance are vividly set forth—with many a lively *excursus* on the evils of even the most moderate use of stimulants—so it would be perfectly proper to exhibit in detail the baseness of a system of politics in which private interest takes the place of public duty. The case is more urgent by far, in our opinion, than the case for "temperance" instruction for this reason, that there is already a vast body of sentiment in the country favorable to temperance and even to total abstinence; whereas there can not be said to be any vast body of sentiment favorable to pure, honest, and disinterested politics. Every man occupying an important political position knows the kind of solicitations he receives for all sorts of things possible and impossible. He knows how often he is assured that unless certain offices, contracts, etc., are disposed of in a certain way there is no earthly chance of his party succeeding in the next contest in congressional district so-and-so. Every such man knows also that it is not only from the ignorant and socially inferior that such communications proceed—that, on the contrary, men of substance and reputation are their authors in perhaps the majority of cases. The assumption may be said to be almost universal that a man's vote is his own, and that in casting it he has nothing to consider but his own interest. That it is disgraceful to withdraw support from a party in which a man professes to have confidence and give it to one in which he professes to have no confidence, simply because some petty contract job or office is not disposed of to his

liking, does not seem, broadly speaking, to be in anybody's thoughts. The politicians ignore it entirely in all their calculations. Side by side, therefore, with the pictures drawn in the "temperance" lesson of the reeling, brawling inebriate, it would be well, we think, to place a picture of the citizen who, boasting that he belongs to a free State, yet holds his vote in fee for some trumpery office, and openly threatens to betray causes on which at times he grows eloquent if his private demands are not met. It is not always for himself personally that the free and enlightened elector wants an office. It may be for his brother, his father-in-law, his nephew, or his business partner; but whatever it is that he wants, or for whomsoever he wants it, he makes no scruple about using his franchise and such political influence as he possesses in order to compass his ends. Often the demands that are made are flagrantly unjust; sometimes they involve wasteful expenditure of public money; but none the less are they pressed by men who exult, as we have said, in the freedom of our institutions, and look with mingled pity and contempt upon communities that are content to dwell under the baneful shadow of some monarchical form of government. A splendid text-book could be made for the instruction of American youth if some prominent statesman would make a selection from his correspondence with office-seekers and wire-pullers, with tariff-mongers and contract jobbers. We say this matter is more pressing—far more pressing—than instruction in temperance, for the reason that if the youth leaves school unwarned and unfortified against the abuses of politics, he will almost at once find himself in an atmosphere in which conscience in regard to such matters is wholly ignored; he will be caught in the wheelwork of the political machine and will become, while yet a youth, a political machinist himself.

The question as to how a low tone of political morality acts upon the general morals of the community is one on which we can not enter today. What we wish to insist on is that there is a crying need for explaining to the youth of the country not so much the technical details of our system of government—though every boy and girl leaving school should have correct general ideas on that subject—as the true principles which should govern political action here and everywhere, and the particular abuses, dangers, and diseases to which our own political system is exposed. Above all, the simple principle should be inculcated that political power can never be properly regarded as a private possession.

THE RACIAL GEOGRAPHY OF EUROPE.

It may savor of undue presumption to assert that the English language is the proper medium through which the anthropological history of Europe should first find expression. At first it would seem that the continental nations were most competent to unravel their own past history. This is indeed true, so far as each by itself is concerned. But when the task of combining them into a continental whole arises, the tables are turned. In no other department of science has political jealousy and hatred worked to greater harm than in anthropology; for Europe is divided into two armed camps—one led by the French, the other dominated by German influence. Their methods of work, their terminology, their conclusions, are all conflicting. Each claims priority, and each has a racial history of Europe which is suited to its own purpose. Hence

the necessity that the delicate and judicial work of combining the truth which is revealed to each and of rejecting that which is false, should fall to those who lie beyond the reach of national prejudice. Writers in England—Beddoe and Isaac Taylor—have so far been most successful in this comprehensive work. It is now essayed for a third time in the series of papers upon the Racial Geography of Europe, which begins in this number. The Monroe doctrine forbids that we should intermeddle in European politics. The effect of this political neutrality should be to keep our hands free and our minds clear in science. In itself it furnishes a justification for our foreign intrusion into the European field.

During the civil war, while the first great investigation upon living men was being prosecuted upon nearly a million recruits in our armies, the United States held a proud place of leadership in that branch of the science of anthropology which deals with our own race in the life. This tremendous task exhausted all our energies at the outset; attention was directed to the American aborigines, and the white man was forgotten. This is one of several reasons competent to explain the popular ignorance and scientific neglect among us of a very live subject. To the average American reader, the word anthropology, if it conveys any meaning at all, conjures up visions of Indians, Hottentots, Fijians, and other savages, or perhaps of museums and curiosities, of Peruvian and Egyptian mummies, cave-dwellers, and the like—so far have primitive ethnology and archæology dominated the science.

Another reason why we in America have passed by this line of inquiry is because the conditions here have not invited research. Our own population is so recent, so artificial, such a hodge-podge of all civilized peoples, that science stands aghast at the problem of finding order in such chaos. In Europe all is, or was until recently, quite different; so that even now, after the railroad and the factory have disturbed the racial peace of the continent, the remnants of law and order still remain.

A special feature of this series of papers will consist of the maps and portraits with which the articles will be amply provided. Every portrait will be accompanied by precise data, obtained from measurements on the living subject. The leading experts all over Europe, among them Drs. Ammon in Baden, Beddoe in England, Collignon in France, Livi in Italy, Janko in Hungary, Kollmann in Switzerland, Ranke in Bavaria, and others, have kindly aided in this work; so that a large collection of racial portraits of permanent value will be presented. With these will be combined all the anthropological maps of value already published, as well as many entirely new ones. Each of these has been especially prepared for this purpose, indicating the exact distribution of each type of man or physical race trait, shown in portrait and described in text. By this means it is hoped that the interests of true science may be subserved; and that at the same time a necessarily technical subject may be rendered comprehensible and interesting to the general reader.

In the first paper of the series, printed in this number, the relation of language to race and nationality, with the changes it undergoes through the distribution of population and the influence of environment, are considered. The next paper will deal with the shape of the head as an ethnic characteristic; the third with the color of the hair and eyes—that is to say, with the distri-

bution of blondes and brunettes; and the fourth the stature. Then the association of these into three race types—the Teutonic, the Alpine, and the Mediterranean—will follow. France, Germany, the British Isles may then be taken up, each by itself, with consideration of special topics, such as the Basques, the Etruscans, living representatives of the Cro-Magnon race, and the like. Thus the way will be prepared for the still broader questions concerning the ultimate origin of the three races above named, with their relation to the negro and the people of Asia. The intention of the whole series will be to give a living picture of the people of Europe, and to analyze it for the benefit of the student of history and sociology.

SCIENCE AND HUMANITY.

WE noticed last month the anxiety of a high ecclesiastical dignitary lest the world under the guidance of the modern scientific thought should be given over completely to cruelty and selfishness; and our attention has since been drawn to an article in a Toronto educational journal which seems to be in some measure inspired by a similar apprehension. We say "in some measure" only, for the writer is in evident sympathy with the work of science as a whole, and is chiefly concerned with the moral evils which he thinks will ensue from the scientific practice of vivisection.

The question as to the value of vivisection for the advancement of scientific theory is a large one, upon which we are not prepared to enter. Suffice it to say for the present that, while some diversity of opinion exists on the subject, the great majority of teachers and experimenters in biology and physiology believe that it affords most important aid in the prosecution and illustration of their studies. That the practice is liable to abuse in careless or indifferent hands may be readily admitted, but it must be said at the same time that the feeling of the scientific world in general is as strongly opposed to any needless infliction of suffering on the lower animals as that of the unscientific world can be. It is recognized that the practice should only be resorted to in a guarded manner, for definite ends, and should be accompanied by whatever alleviations of pain it is possible to introduce. No condemnation could be too strong for any purposeless cruelty at the expense of sentient creatures, or any profession of indifference to the pains which they are necessarily compelled to undergo. The great safeguard of the scientific world against such misuse of the power we possess over the dumb creation lies in the fact that the one professed and never-forgotten purpose of the practice now in question is the mitigation and prevention of human suffering. If the question were asked whether, on the whole, the animal creation had gained or lost by the advance of scientific thought, there could be little doubt about the answer. It is since science became a prominent occupation of men's minds that qualms of conscience have begun to be felt about some forms of sport in which animal life is sacrificed, and that measures have been taken to secure merciful treatment for animals in course of transportation, and for the prevention of various forms of cruelty and neglect through which animals suffered at the hands of man. That much remains to be done in these directions is undoubted, but we may be sure of this, that the more animals become the subject of scientific study and treatment, the better on the whole will be their lot. It may be that

the need for vivisection will in time wholly pass away, the truths which it is adapted to teach having in the main been acquired. There will then remain as the result of temporary suffering a body of knowledge available for the prevention of suffering, not only in the human race, but among the lower animals as well. What may be called the metaphysics of the subject is difficult to deal with, and we can not follow our Toronto contemporary on that ground. In a practical matter like this we feel that it is safer and better to trust the instincts of humane men; and among those who have approved of a limited and careful use of vivisection are to be found many whose humanity and sensibility no one would doubt. Science and humanity go hand in hand for the simple reason that *science is human*. In matters of this kind we are therefore disposed to trust the scientific spirit as being essentially a spirit of mercy and benevolence, a minister of good to mankind, and not to mankind only, but to the lower tribes of life as well.

Scientific Literature.

SPECIAL BOOKS.

EARLY in 1895 the reading and thinking world was given something like a galvanic shock by the appearance of Nordau's book on Degeneration. It represented much of the genius of the later nineteenth century—genius that has produced many of the most widely admired works of art and literature—as being a variety of wholesale derangement that was developing in a considerable part of the race. Such a diagnosis could hardly pass unchallenged. The magazinists hastened to answer Nordau. An anonymous English writer put forth a volume controverting his position, and a fellow-countryman of Nordau, Dr. *William Hirsch*, has so modified a work that he had under way as to make it also a reply.* Dr. Hirsch's book is first an examination, in the light of the latest advances made in neurology, of the much debated question, How closely is genius related to insanity? After briefly defining the limits of insanity he examines the psychology of genius and then compares the diseased with the supernormal mind. He holds that—

> Genius in different departments is referable to the most diverse psychical conditions. Psychical faculties and characters which in one case constitute the essence of genius, in another case are inconsistent with the action of genius. In short, definite psychical characters common to all genius are not to be found. One would seek in vain any common psychological explanation of the greatness of a Paganini and a Bismarck, of a Mozart and a Napoleon.

While he refrains from fitting a definition to either genius or insanity, he does not hesitate to compare the two. He takes up the chief symptoms which other authors have found in both men of genius and the insane. Among these are hallucinations, melancholy, the lively fancy of

---

* Genius and Degeneration. By Dr. William Hirsch. New York: D. Appleton & Co. Pp. 333, 8vo. Price, $3.50.

the *littérateur* and the lying of the imbecile, and the fact that some great men have actually had attacks of insanity. Yet he deems all these to be mere resemblances, not real affinities. Great men are not to be measured by the same standard as ordinary beings, and the reason why they are often deemed insane by those around them is because their superior powers are not understood. Taking up the subject of degeneration, he discusses the views of Morel, Krafft-Ebing, and Lombroso as to the characteristics of degenerates, and concludes that "in consequence of its common cause in all cases—namely, mental instability, discord of the mental faculties—the cases always have something to characterize them, and they give to the competent observer no occasion to confound them with great, fully developed, and harmonious minds." In his chapter on Secular Hysteria, Dr. Hirsch first comes in conflict with Nordau. He flatly contradicts the assertion of the latter that neurasthenia and hysteria are epidemic as they have never been in former centuries and are vitiating the literature, art, and culture of the time. He says:

> Had Nordau in his sharp critique of existing conditions in the fields of society, literature, and art made no pretension to any other standpoint than that of the æsthetician and art critic, his work, in spite of its many eccentricities and falsities, would undeniably not have been without service, for he lays the scourge that is their due upon many a folly and absurdity of our time. But when he wraps himself in the solemn garb of science and, assuming the position of a psychiatrist, hurls the ban of degeneracy and hysteria upon everything that does not meet his approval, he can only be called a psychiatric *dilettante*.

He regards as Nordau's chief error the drawing of psychiatric conclusions from his purely subjective criticism of works of art, without regard to the purpose of the artist or author. In order to make his meaning clear he takes Richard Wagner as an example, and gives quite an extended analysis of his compositions, maintaining that they give no such evidence of degeneracy as Nordau alleges. In reading Dr. Hirsch's pages one can not help being impressed with his fairness. He never fails to admit what he can agree with in his opponent's position. At the same time he is a good fighter, and his blows fall thick and heavily upon those things that he undertakes to combat.

Although prepared chiefly for certain professional and business men, the little book on *Theater Fires*, recently published by Mr. *Gerhard*, deals with a matter which often becomes of wide and painful interest.* From the statistical pages, with which the author introduces his subject, we learn that before 1878 five hundred and sixteen theaters had been completely destroyed by fire. Theaters are in most danger from fire when they are new and their apparatus may not be in perfect working order, and again when forty to fifty years old and much of the apparatus has become worn out. The causes of theater fires are many and various, but most of them arise, naturally, on the stage or in the dressing rooms. Panics in theaters also have a number of causes besides the actual appearance of fire. One may be started by a false alarm, by an alarm of fire in the neighborhood, by the unannounced darkening of the house, by the plunging of a frightened horse on the stage, etc. As measures for preventing outbreaks of fire

* Theater Fires and Panics. By William Paul Gerhard. New York: John Wiley & Sons. Pp. 175, 12mo. Price, $1.50.

Mr. Gerhard recommends the isolation of the building so far as practicable, fireproof construction, using brick and terra cotta in preference to stone and avoiding exposed ironwork, the use of incandescent electric lights, proper storing of scenery, removal of rubbish, etc. If a fire does start, the building should be so divided as to localize it. The stage should be separated from the auditorium by a fire wall. The proscenium opening should be fitted with a fire-resisting curtain, closing as nearly as possible hermetically. There should be as few other openings in this wall as possible, and all of them kept closed by fire doors. The safety of the spectators and stage people can be best provided for by having adequate exits. All other devices Mr. Gerhard ranks as subordinate. The exits, he says, should be arranged so as to widen as they approach the outside of the building. There should be no stinting of exits for the occupants of the galleries, who have often been suffocated in large numbers by the rising smoke and hot gases of combustion. Many other measures for preventing or restricting the damage done by fires are named by Mr. Gerhard, and he describes with considerable detail what he deems the best appliances for putting out theater fires before they have gained much headway. The volume is made up of three papers prepared for different occasions, hence there are some repetitions in it. This not very serious fault doubtless could have been wholly or largely removed by a moderate amount of editing. A list of books and magazine articles on theater construction and protection is appended. Every theatergoer should read the volume, so that he may know when he is in a safe house, and should never again allow the most seductive bill to tempt him into a death-trap.

It is a strong presumptive recommendation of Mr. *Parry's Evolution of the Art of Music** that it was nine years in preparation. The examination of the book reveals throughout evidences of the thorough study and careful work implied by that term of years, and of effort to go to the bottom of the subject. The author seems to have found a firm basis for his deductions, and expresses them clearly and distinctly, without any of the hazy uncertainty and vague indefiniteness that mark the majority of attempts to analyze music and make them far from satisfactory. The origin of music is found in natural or spontaneous vocal expressions of feeling and sensibility, such as are common to all sentient beings. Man has developed and extended them and formulated them according to his stage of culture, and the purpose in this book is to point out how and by what steps he has done this and brought musical expression to its present high condition. These utterances pass within the range of art when they take any definite form, just as speech begins when vague signals of sound give place to words. When these musical figures become definite enough to be remembered, scales are formed, or series of notes which stand in some recognizable relation to one another in respect of pitch. The connection of music, or vocal, with dancing or muscular expression of feeling gives rise to rhythm, and we have all the elements of the art. The scales, ancient and modern, and of various races, are described and analyzed. A step higher than the primitive fragments of tune and rhythm of savage music—the first stages of musical development—is folk music, in which an appearance of orderliness and

* The Evolution of the Art of Music. By C. Hubert Parry. New York: D. Appleton & Co. (International Scientific Series.) Pp. 342. Price, $1.75.

completeness is given; and we have the folk music of various tribes and nations, described and illustrated with specimens, in its different degrees of development. Next, the religious aspect of music is referred to, and the beginning of harmony is discussed in connection with the appearance of Christian church music. The era of pure choral music succeeding this is followed by the rise of secular music, with the history of opera swaying to and fro in the struggle between the musical and dramatic elements for predominance. Instrumental music is next studied in its early and middle stage; the sonata; and finally the modern developments, with all their varieties of style and form. In these discussions the typical works of each age, form, and style are described and analyzed, the work done by the composers who have made epochs in the progress of the art or established new forms is examined into, and each point is illustrated by the introduction of scores. Wagner is the latest master who has left a distinct mark in the growth of music, and the nature and effect of the most characteristic features of his compositions are inquired into in what seems to us a truly judicial spirit.

GENERAL NOTICES.

Chemistry in Daily Life * embodies the substance of a course of lectures delivered by Dr. *Lassar-Cohn*, Professor of Chemistry in the University of Königsberg, to a society in that town modeled after the celebrated Humboldt Academy of Berlin. The book is written in a popular style, and covers a very wide and important field. It is really a technological handbook of what is perhaps best described as household chemistry The subjects treated are necessarily extremely various, and, except from the side of their importance in the affairs of everyday life, are not in many instances very closely connected. The Physics and Chemistry of Breathing, Argon, Composition of Fats, Tetravalency of the Atom of Carbon, Vaseline, and Incandescent Gaslights are some few of the special headings in the first two chapters, and will perhaps serve to indicate the great variety of topics treated. Perhaps the most important chapters are the first five, which deal chiefly with the chemistry of physiology. Tanning and bleaching are given a chapter. Oil painting, modern explosives, glass manufacture, photography, and metallurgy are other subjects receiving special attention. The work is necessarily more or less superficial, but it contains much information of importance to the ordinary householder. The translation seems to have been very well done.

The importance which proper nursing is known to have in therapeutics has led of late years to systematic courses in this subject, both at general hospitals and in special schools. These courses have made special text-books a necessity. Dr. *Wise's* work * is the latest handbook of this sort to reach us. As the author says, the chief difficulty in a text-book of nursing is to strike a happy medium between a medical and a high-school text-book—to avoid extreme technicality on the one hand and a too superficial treatment on the other. Dr. Wise seems to have accomplished this. The first volume, with the exception of the last four chapters, which give some general instructions for the preparation and care of the sick-room, is devoted to a statement of the simpler facts of anatomy, physiology, hygiene, and sanitation which have a bearing on nursing. It is the second volume which is the real text-book. Methods of applying local remedies and bandaging are first taken up. The treatment of fractures, dislocations, inflammation, and hæmorrhage are next considered. Emergency work, artificial respiration, con-

* Chemistry in Daily Life. By Dr. Lassar-Cohn. Translated by M. M. Pattison Muir. Philadelphia: J. B. Lippincott Co. Pp. 324, 12mo. Price, $1.75.

* A Text-Book for Training Schools for Nurses. By P. M. Wise, M. D. 2 vols. New York: G. P. Putnam's Sons. Pp. 247 and 327, 12mo. Price, $1.25 each.

vulsions, coma, wounds, and burns are discussed in detail. Nervous diseases and insanity receive considerable attention. Bathing, massage, the administration of medicine and food, children's diseases, signs of death, and care of the dead bring us to the last four chapters, which treat of pregnancy, childbirth, and gynæcological nursing in general. The work is intended as a text book, for use in a school or hospital, and should be supplemented by clinical study.

In the preparation of his *Story of the Earth*, Dr. *Heilprin* * has sought to present briefly, forcibly, and in a more popular form than in most books of a similar nature, the general facts of geology. Avoiding the recapitulation of numberless details with which authors are easily tempted to burden a work on this science, and making his account narrative rather than adopting an analytical method, he has endeavored to make the book comprehensive enough to meet the needs of the average student, and enlist the attention of readers who would pass by a difficult technical work and would yet not be satisfied with an ordinary elementary one. He has made it a model of compactness, simplicity, lucidity, and readableness, touching upon all essential points, and dwelling on them long enough to make them understood, yet without tiring the reader. The illustrations are numerous, all photographs from the things themselves, largely American, and represent clearly what it is intended to show. First, the rocks are described as a whole; then "what a mountain teaches" is told; the operative forces in geology are presented—snow and glaciers, underground waters, the forces in the earth's interior, volcanoes and earthquakes, and corals and their island products; three chapters are given to the description of fossils; the physiognomy of the land surface is delineated; and the more useful metals and minerals, building stones, soils and fertilizers, and some of the commoner rock-forming minerals and minerals occurring in rocks are described.

The great interest which Prof. Weismann's theories regarding the problems of heredity have excited has led to the translation of a work by Dr. *Oscar Hertwig*, *The Biological Problem of To day*,* which was published last year in Germany. The book is practically a criticism of Weismannism, Dr. Weismann being the most prominent upholder of what is called the Præformation theory. The main question at issue is a purely biological and very technical one—namely, the process by which organic development is carried on. The Præformationists believe that the future organism exists in the germ, with its various parts differentiated, but of course so extremely minute as to render any physical appreciation of this fact quite impossible. The upholders of what is called Epigenesis, on the other hand, insist that in the beginning there is no such differentiation, but that the original germinating mass is practically homogeneous, and the subsequent specialization is "impressed" on different portions of similar material. Dr. Hertwig's book consists of a statement of his reasons for believing in epigenesis. Most of them are based on data gained during investigations of cell structure and growth, and by means of experiments on the lower forms of organized matter. Dr. Hertwig's name is associated with many of the most important advances in our knowledge of cells and embryology, and his views on the question in di-pute are of the utmost value. In his introduction the translator has given a brief general statement of the early stages in the development of the vertebrate, which is intended as a help for readers not familiar with the subject of embryology.

We have just received a third edition of Dr. *Brinton's Myths of the New World*. The first edition, which appeared so long ago as 1868, has been somewhat superseded by later publications, and, while many of the recent contributions to the subject are not considered by Dr. Brinton to be as satisfactory as the work of the earlier writers, many of the opinions put forward in the original work as theories have now been accepted by most students of mythology, and require a restatement in more emphatic form. In its original edition the work was intended more for the thoughtful general

* The Earth and its Story. By Angelo Heilprin. Boston, New York, and Chicago: Silver, Burdett & Co. Pp. 267, with Sixty-four Plates.

* The Biological Problem of To-Day. By Prof. Dr. Oscar Hertwig. New York: The Macmillan Co. Pp. 148, 16mo. Price, $1.25.

reader than for the antiquary, and this idea has been kept in mind during the revision. There is a useful bibliography appended. (Philadelphia: David McKay, $2.)

The *Coming Ice Age*, by *C. A. M. Taber*, is an attempt to show the manner in which an ice age is being brought about, and is an extension, the author says, of a treatise published in 1894 on The Cause of Warm and Frigid Zones. The author's notion seems to be that ocean currents, in conjunction with winds and slight modifications in coast line, are sufficient to bring about the great changes in climate necessary to produce a glacial epoch in present temperate regions. The author sums up as follows: "Consequently, there seems to be no method yet devised through Nature's mode of action that can carry sufficient heat into the antarctic latitudes to melt the ice sheets from the southern continent, or even arrest their growth, while the Cape Horn channel maintains its present width and depth. Therefore the increase of glaciers and icebergs will slowly continue until a glacial epoch is perfected."

The *Transactions of the Kansas Academy of Science* for the years 1893–'94 has just come to hand. The volume begins with an article by the retiring president, entitled "Small Things," in which he calls attention to the great importance in scientific investigation of apparently trivial details. There are a number of mathematical papers, among which may be mentioned The Inverse of Conics and Conchoids from the Center, and Harmonic Forms. A long and well-illustrated account of Kansas Mosses is the most important paper in the botanical section. Mr. Robert Hay contributes a paper on the Economic Geology of the River Counties of Kansas, to which is appended an exhaustive bibliography.

Modern Optical Instruments, by *Henry Orford*, is intended apparently as an elementary text-book of practical optics. The construction and properties of the human eye are described in the earlier pages, as are also some of the commoner aberrations and defects to which our eyes are subject. The following chapters, which deal with the theory and practice of ophthalmoscopic examination, with the various forms of spectacles and the principles governing their use and selection, the stereoscope, the optical lantern, and the spectroscope, contain a very good elementary consideration of these various subjects. (Macmillan, 80 cents.)

Special Method in Natural Science is the title of No. 4 of a series of special methods in the common-school studies. It is intended to give the teacher "a general view of the problem of science-teaching." As in most books of this class, many of the suggestions seem trivial and unnecessary. Some of the hints, however, are good, and very possibly the others may be useful to that large class of teachers who are such through "circumstances," and not because of any special training or ability which they have for teaching. (Public School Publishing Company, Washington, Ill., 50 cents.)

An extended work on *Oceanic Ichthyology*, by the late Dr. *George Brown Goode* and Dr. *Tarleton H. Bean*, has been issued by the Smithsonian Institution. It consists of technical descriptions of all forms of fishes found in the seas of the world, accompanied by an atlas of 123 plates bearing 417 figures. The text forms a volume of 553 quarto pages and contains many new facts. This treatise appears at a time when no deep-sea explorations are in progress, and the final ichthyological results of all past expeditions have been published. The authors have aimed to assemble in it all existing scientific data concerning oceanic fishes, and it is not likely to be superseded as an authority for many years. Its preparation was carried on in great part amid the pressure of official duties. It was first ready for printing in 1885, was revised and rewritten in 1888 and in 1891, and again in 1894 as it was going through the press, these changes being made necessary by successive publications of new material. For the senior author, whose death occurred within the same month in which it was issued, this is a truly monumental work.

The *Tenth Annual Report of the Commissioner of Labor*, for 1894, makes a thick octavo volume and another about half as thick. It is devoted to strikes and lockouts, covering those occurring in the United States from January, 1887, to June, 1894, and forming a continuation of the Third Annual Report. For each disturbance there are

given the occupation and number of the workers concerned, locality, cause or object, duration, whether successful or not, losses to employers and employees, etc. The main table of strikes is arranged by States, years, and industries, and occupies over 1200 pages of the first volume. The lockouts are presented in a table of 108 pages. The second volume contains summary tables in which the same information is presented from various aspects. From the commissioner's analysis of the tables, it appears that, of the 10,487 strikes occurring in the seven years and a half, 43·52 per cent were successful, 10·19 per cent partly successful, and 46·28 per cent failed. Of the lockouts—four or five hundred in all—48·87 per cent were successful, 10·15 per cent partly so, and 40·44 per cent failed. For the whole period of thirteen years and a half covered by the Third and Tenth Reports together, the loss to employees from strikes was, in round numbers, $164,000,000; from lockouts, $27,000,000. The losses to employers from the same causes were $83,000,000 and $12,000,000 respectively.

The Pedagogical Series of papers issued by the University of Pennsylvania has for its first number an account of *Three Typical Educational Systems*, by *Lewis R. Harley*, Ph. D. This consists of outlines of the public-school systems of Massachusetts, New York, and Michigan. While often referring to the origin of certain features, Dr. Harley has not undertaken to give a history of school administration in these three States, but rather to represent it as it exists.

The memoir on the discovery of *Argon* with which Lord *Rayleigh* and Prof. *William Ramsay* won the Hodgkins-Fund prize has been issued as one of the Smithsonian Contributions to Knowledge. This remarkable discovery has been widely described in both technical and popular journals, and a revised version of the memoir has been published in the Philosophical Transactions. The paper is here presented in the form in which it was submitted to the committee.

The Peabody Museum at Cambridge has begun a series of quarto publications with a memoir on *Prehistoric Ruins of Copan, Honduras*, being a preliminary report of the explorations made by the museum from 1891 to 1895. This report has been compiled by George B. Gordon from his field notes and those of Marshall H. Saville and John G. Owens, who at different times have carried on the explorations under the direction of the museum. It is intended to give only a general description of the ruins and a summary of the work of the several expeditions. It will be followed by special papers on the discoveries made. The museum has had the co-operation of Alfred P. Maudslay, the English explorer of Central America, and has adopted the names, letters, and numbers with which he has designated various portions of the ruins and some prominent sculptures, while for new features the letters and figures have been continued in sequence. The memoir is illustrated with a plan of the ruins and a considerable number of plates and figures representing stelæ, altars, and other pieces of sculpture. The explorations were made possible by the contributions of subscribers, whose names appear in the report.

It is a serious warning that is put into story form in *Cursed before Birth*, by *J. H. Tilden*, M. D. (the author, Denver)—a warning to women who shirk the cares of motherhood, to girls who think it is a benefit to be noticed by old and wealthy men, and to young men on whose shoulders rests the guardianship of a home. It is a warning also to those rapacious miscreants who imagine that they can prey upon the virtue of their communities without coming to a day of reckoning. Dr. Tilden writes with much earnestness, and there are many who should heed his admonition.

An elementary book under the title *Uncle Sam's Letters on Phrenology*, originally published in 1842, has been reprinted recently (Fowler & Wells Company, paper, 50 cents). The letters are written in a familiar style, with considerable pleasantry, and contain many illustrative anecdotes and allusions to public men and affairs of fifty years ago.

On account of the important position occupied by the alternating current transformer in systems of distribution for light and power, Prof. *Frederick Bedell*, of Cornell University, has been led to prepare a treatise on *The Principles of the Transformer*. "Ten years ago," the author re-

marks in his preface, "the transformer was born, and in one decade it has attained its maturity. During its development it has been the subject of much investigation and study and has been carefully considered from every standpoint, so that complete novelty of treatment is now scarcely looked for—in fact, would not be desirable. There is a demand, however, for a united and logical exposition of the principles involved. To this end the writer has turned his efforts and contributes the following pages." The subject has been kept within well-defined limits. Thus, while systems of distribution are briefly reviewed as bearing directly upon the principles of the apparatus, the subjects of fuel and boilers and of central-station operation have been excluded as irrelevant. The theory of the alternator is given in brief. The author has taken especial pains to make his book tend toward uniformity rather than diversity in notation. The C. G. S. system has been used for expressing magnetic quantities for the reason that international agreement as to names for magnetic units has not yet been secured. In elucidating the principles set forth, two hundred and fifty diagrams and other cuts are used, and the volume is adequately indexed.

The *School Algebra*, by *Emerson E. White* (American Book Company, $1), has among its distinctive features the early introduction of the equation, the application of arithmetical approaches to algebraic processes and principles, and the immediate application of facts and principles in simple exercises. Processes that do not appear generally in school algebras are the multiplication and division of polynomials by detached coefficients; a general method of factoring trinomials; the solution of quadratic equations by factoring; and in the closing chapters a simple treatment of undetermined coefficients, determinants, and curve tracing.

The Romance of Industry and Invention, consisting of articles selected by *Robert Cochrane* from the pages of Chambers's Journal, with additions, is a nice book for Scotch and English readers, but we fail to see why it should come to America (Lippincott, $1.25). One would suppose from reading it that the biography of the Englishman Wedgwood was the whole history of the pottery industry; that America has no cotton mills, but only serves with India and Egypt to furnish raw material to England; that only the gold fields in British possessions are worth more than a mere allusion, while Ericsson's Monitor with its revolving turret never existed. On the other hand, it does appear that the chief inventors of sewing machines were Americans; more credit is given to Morse for the telegraph and Field for the Atlantic cable than is usual in British popular writings; while Bell and Edison can not be hidden in any account of their inventions; and there is actually a distinct admission that "from the time of their last war with us down to within a quarter of a century ago our Yankee neighbors generally seemed to be a little ahead of this country in maritime matters."

A graphic lesson in *The Effects of Erosion*, due to forest destruction, is afforded in a chart recently issued by the United States Department of Agriculture. It bears three colored pictures showing respectively How the Farm is Lost, How the Farm is Regained, and How the Farm is Retained, each accompanied by a few lines of explanation and counsel.

In August, 1896, the first number of *The Hypnotic Magazine* appeared (Psychic Publishing Company, Chicago, $2.50 a year). It is edited by *Sydney Flower* and is devoted to "an investigation of the science of hypnotism, its uses and abuses, and its therapeutic possibilities." Among the articles in the first number is a report by Herbert A. Parkyn, M. D., of cases treated in the daily clinic conducted by him in Chicago. Other contributors are Charles G. Davis, M. D., W. L. Stevenson, M. D., and W. X. Sudduth, M. D. The contributors, although showing the confidence of enthusiasts, succeed in avoiding the extravagances that sometimes make hypnotism ridiculous, while the tone of the Introduction and other editorial expressions is modest and enlightened.

Visible Speech is a system of speech notation which uses symbols designed to suggest the proper positions of the vocal organs. It has been presented to the public by its author, Prof *Alexander Melville Bell*, in books adapted to a variety of needs. One

now before us, *English Visible Speech in Twelve Lessons* (Volta Bureau, Washington, 50 cents), is intended as a first book for the use of children, foreigners, and the deaf in learning to read English. Each lesson is accompanied by cuts showing the positions of the vocal organs denoted by the new symbols introduced in that lesson, and by a page of directions for the teacher. There is also a table of vowels occurring in foreign languages. The first few reading exercises are adapted to children—most of the others to adults.

Under the title *Cheerful Philosophy for Thoughtful Invalids*, a little book of forty pages has been published by *William H. Clarke*, which is well calculated to aid those bodily afflicted in rendering their lives "less burdensome to themselves and more useful to others." While it is religious in tone it is not sanctimonious, and the practical application of its encouraging counsel is shown in several anecdotes (E. T. Clarke & Co., Reading, Mass., 50 cents).

According to the *Report of the United States Life-Saving Service*, the number of disasters within the scope of the service during the year 1894–'95 exceeded that of any previous year by seventy-nine. This large excess was in part due to the extension of the service, but chiefly to the conditions of weather which prevailed. The proportion of loss of life and likewise of property was smaller than in any year but one since the general extension of the service on the sea and lake coasts. The general superintendent still finds it necessary to urge upon Congress a more liberal and discriminating scale of payment for district superintendents and surfmen.

The somewhat ambiguous title of *The Nursery Book* denotes a guide to the multiplication of plants by Prof. *L. H. Bailey*, the third edition of which appears in The Gardencraft Series (Macmillan, $1). While there is a short chapter devoted to methods of sowing seeds, the book is mainly occupied with grafting, cutting, and similar processes. A special feature is the alphabetical Nursery List, telling how every plant generally known to gardeners is propagated. There are also a glossary and an index. The descriptions are illustrated with one hundred and fifty-two cuts. For this edition, the author says, "the entire volume has been thoroughly ransacked and renovated."

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Delaware College Station: The Increase of the San José Scale in Delaware during 1896.—Michigan State College: Fattening Lambs; Feeding Corn Smut; Pig Feeding.—New York Station: Strawberries; Milk, Fat, and Cheese Yield.—Ohio State University: The College of Agriculture and Domestic Science.—United States Department: Bibliography of the More Important Contributions to American Economic Entomology; Proceedings of the Eighth Annual Meeting of the Association of Economic Entomologists; A Bacterial Disease of the Tomato, Eggplant, and Irish Potato.

Bulletins, Catalogues, Proceedings, etc. Field Columbian Museum: Annual Report of the Director.—Health, Rhode Island State Board of: Seventeenth Annual Report.—Iowa State University: Bulletin from the Laboratories of Natural History, Vol. IV, No. 1.—Labor, Bulletin of Department of, November, 1896.—Minnesota Botanical Studies: Bulletin No. 9.—Philadelphia Academy of Natural Sciences. Pp. 515–562.—Peabody Education Fund: Proceedings of Trustees at Thirty-fifth Meeting.—Purdue Society: Proceedings of, 18.6.—Smithsonian Institution: Annual Report of the Board of Regents of, to July, 1894.—Culin, Stewart: Mancala, the National Game of Africa.—Gray, Thomas: Smithsonian Physical Tables.—Mason, O. T.: Primitive Travel and Transportation.—McGuire, J. D.: A Study of Primitive Methods of Drilling.—Satoh, A.: The Wooden Statue of Baron II Kamou-no-Kami Naosuké, Pioneer Diplomat of Japan.—True, F. W.: A Revision of the American Moles.—Wilson, Thomas: The Swastika.—Texas Academy of Science: Are we Conscious Automata?—United States Army: Annual Report of the Chief of Engineers, 1896.—United States Fish Commission: Description of a New Species of Shad from Alabama; A Check List of the Fish and Fishlike Vertebrates of North and Middle America.—United States National Museum: Description of a New Genus and Four New Species of Crabs from the West Indies; Preliminary Diagnoses of New Mammals from the Mexican Border of the United States.

Education, Report of the Commissioner of, 1894–'95. Vol. I. Pp. 1152.

Farman, D. Auto-cars. New York: Macmillan & Co. Pp. 249. $1.50.

Hutchinson, H. N. Prehistoric Man and Beast. New York: D. Appleton & Co. Pp. 298. $3.

Keasbey, L. M. The Nicaragua Canal and the Monroe Doctrine. New York: G. P. Putnams. Pp. 621.

Kelly, Mrs. M. A. B. Short Stories of our Shy Neighbors. New York: American Book Co. Pp. 214. 50 cents.

Keyes, Charles Rollin. Bibliography of Missouri Geology. Pp. 533.

Kipling, Rudyard. The Seven Seas. New York: D. Appleton & Co. Pp. 209. $1.50.

Labor, Twelfth Annual Report of the Connecticut Bureau of. Pp. 315.

Lanessan, J. L. de. Principes de colonisation (Bibliothèque Scientifique Internationale). Paris: Félix Alcan. Pp. 283. 6 francs.

Library of the World's Best Literature (45 vols.). Vols. I and II. Edited by Charles Dudley Warner. New York: The International Society. Pp. each, 484.

Loomis, Eben J. An Eclipse Party in Africa. (Illustrated.) Boston: Roberts Bros. Pp. 218. $4.50.

Loew, Oscar. The Energy of Living Protoplasm. London: Keegan Paul, Trench, Trübner & Co. Pp. 115.

Matthews, Charles Thompson. The Story of Architecture. New York: D. Appleton & Co. Pp. 468. $3.

New York State Board of Charities, Annual Report of, for 1895. Pp. 541.

Niewenglowski, G. H. La Photographie et la Photochimie (Bibliothèque Scientifique Internationale). Paris: Félix Alcan. Pp. 284. 6 francs.

Perkins, Charles A. Outlines of Electricity and Magnetism. New York: Henry Holt & Co. Pp. 277. $1.10.

Photographic Annual for 1897. New York: The Scovill & Adams Co. Pp. 270.

Poulton, Edward B. Charles Darwin and the Theory of Natural Selection. New York: The Macmillan Co. Pp. 224. $1.25.

Putnam, George Haven. Books and their Makers during the Middle Ages. New York: G. P. Putnam's Sons. Pp. 538. $2.50.

Reprints. Mills, Wesley: Psychic Development of Young Animals, Part V (Transactions of the Royal Society of Canada).—Smith, Harlan I.: Certain Shamanistic Ceremonies among the Ojibwas (American Antiquarian, September, 1896).—Trelease, William: Botanical Opportunity (Botanical Gazette, vol. xxii).—Ward, Lester F.: The Purpose of Sociology (American Journal of Sociology, November, 1896).

Richardson and Pierce. The National Electrical Code. Chicago: 510 Royal Building. Charles A. Hewitt. Pp. 222.

Ruedebusch, Emil F. The Old and the New Ideal. Mayville, Wis.: The Author. Pp. 347. 50 cents.

Shinn, Charles Howard. The Story of the Mine. New York: D. Appleton & Co. Pp. 272. $1.50.

Spencer, Herbert. The Principles of Sociology. Vol. III. New York: D. Appleton & Co. Pp. 645. $2.

Waldo, Frank. Elementary Meteorology. New York: American Book Co. Pp. 373. $1.50.

Wright, G. F. The Ice Age in North America. (Fourth edition.) New York: D. Appleton & Co. Pp. 648. $5.

Fragments of Science.

American Man in the Ice Age.—Very important evidence has been found during the past year of the existence of man in North America during the Ice age, or at least the latter part of it. The two chief items, coming from different parts of the country and established by the evidence of different observers working independently, are of sufficient force to make the conclusion exceedingly probable. First, we have the discovery by Mr. Volk, reported to the American Association by Prof. Wright and enlarged upon by Prof. Putnam, of argillite implements in the undisturbed glacial gravel near Trenton. The excavations, carried on during two years by Mr. Volk, in such a manner and through such formations that mistake was practically impossible, revealed a disturbed upper layer of sand and gravel, in which were implements of flint and argillite, and beneath this an undisturbed layer, compact and distinctly stratified, in which only implements of argillite were found. The opinion, reached by Prof. Wright and Prof. H. Carvill Lewis fifteen years ago, assigning this formation to "a period when the land stood one hundred and fifty feet below its present level, and when the cold waters from the melting glacier bore ice rafts which dropped their bowlders," is confirmed by Prof. Salisbury in his last New Jersey Geological Report, who holds that "it seems certain that the formation (Jamesburg) was produced during the submergence of the area which it covers," and that it has been only slightly eroded, contrary to the view of Prof. Chamberlin that the glacial deposit was an older one than this, and has suffered great erosions. The fact that only argillite implements were found in the lower stratum, while both flint and argillite are found in the layers above, contradicts the theory that they drifted down through cracks, root holes, etc., for in such drifting there could have been no selection of one kind of implements and exclusion of the other kind. The second piece of evidence was presented by Prof. E. W. Claypole, who described the finding of neolithic axes in digging a well in the blue till, twenty feet below the surface, at New London, Huron County, Ohio. The account of the workman who found the implements, given in full, describing the formations through which he passed in the digging, and confirmed by Prof. Claypole's personal inspection of the premises, is so distinct as apparently to leave no room for doubt. The circumstantial evidence sustaining his testimony is of

the most convincing character. The passage from the yellow till into the blue till, and the occurrence of occasional strata of gravel, are characteristic of the glacial deposits of northern Ohio; and the axe had been subjected to oxidizing agencies characteristic of the deeply covered strata of that immediate vicinity. The Trenton discovery is interpreted as showing that there was a clearly marked succession of human occupancy in the Delaware Valley, in which, from the sole use of argillite implements, a transition occurred to the use of flint and jasper in later times; while in the Ohio discovery the conditions were such as apparently to exclude every supposition but that of the contemporaneous age of the implement with the formatiom in which it was found.

Nature Study in the Chicago Schools.—A plan for systematic outdoor or field work in connection with Nature study, to be carried on by the pupils of the public schools of Chicago, has been reported by a committee of sixty teachers which was appointed in May, 1896, by the Chicago Institute of Education. The features of the plan may perhaps be best understood by indicating the duties of the subcommittees which the general committee has instituted to care for its various special features. First is the executive committee, the purpose of which is to devise ways and means for carrying the whole into effect and to second the efforts and work of the other subcommittees. A committee on maps will prepare maps of the environs of Chicago to assist the pupils and teachers in a systematic study of the country at a convenient distance around the city; these maps to comprise large maps, each including only one of the most conspicuous geographo-geologic features, and smaller maps showing details—the location of the specific features of interest. The maps already made by Prof. T. C. Chamberlin, and kindly offered by him, will be used as the basis of this work. A committee on syllabi is to prepare printed outlines and suggestions which will intelligently and economically direct pupils and teachers in their consideration of the different areas and subjects chosen for study. The syllabus should not be compiled information, but should simply suggest the problems that are furnished for study by each area and indicate lines and methods of investigation. A fourth committee will look in the libraries after the books that may be useful to the pupils engaged in Nature study and available for their use. A committee on instruction and school exhibits will make themselves acquainted with the work of Nature study in the schools and with the teachers engaged in it, and make monthly reports to the committee of sixty of what is actually being accomplished, and will establish at some suitable place a permanent exhibit illustrating the character of the work. A committee of public information will see that all these things are made known and kept in mind. A committee on transportation will try to interest the railroads, etc., in the scheme, and to secure convenient facilities and privileges for the transportation of pupils and parties going out to fields of Nature study. Arrangements will be made for frequent trips of small numbers rather than for larger excursions at longer intervals, which might give the affair too much the air of a picnic. Hence it is suggested that only the pupils of one or two rooms be sent out at a time, under the immediate supervision of their teachers. A committee on finance and a conference committee are also instituted for the purpose indicated by their titles. It is anticipated by the committee of sixty that, when once under way, this plan will be expanded to include every department of school work.

Spitzbergen Explored.—The principal geographical work of the Conway expedition to Spitzbergen was the first crossing of the island, from Advent Bay to Agardh Bay. The country traversed was mapped, its geology was examined, and collections were made of its plants and animals. Afterward the whole expedition sailed northward to the Seven Islands, and through Kinlopen Strait and across Olga Strait to near King Charles Island. An attempt to complete the circumnavigation of Spitzbergen was blocked by ice. The highest peak in the island was ascended. The land animals observed were the bear, arctic fox, and reindeer, of which the last are abundant. Birds are individually numerous, but of few species. All the twenty-five recorded species were observed,

except the snowy owl, and one unrecorded species was seen. The flora is remarkably uniform, and the influence of height has less effect upon it than situation and season. The species found on the mountain summits in the middle of the summer were the same as those observed on the coast at the beginning of spring. As the season advanced, the species first found in flower on the lowlands and in sheltered valleys were succeeded by another set; but at any time it was only necessary to seek exposed and barren positions, or to climb above the snow line, to find the first flora still in flower. Spitzbergen offered better opportunities for geological than for zoölogical or botanical research. One of the main temptations it offers the geologist is a magnificent opportunity for the study of glacial action; for there, says Mr. J. W. Gregory, of the expedition, we may see marine and land ice working side by side. The inland glaciers are very different from those of Switzerland, especially in having no *névé* fields. All the snow that falls on the collecting ground at the head of the glacier turns to ice on the spot. Cases of the formation of typical bowlder clay by land ice were easily found; so, likewise, were instances of the uplift of material through ice. The glaciation of Spitzbergen was solely due to a local ice action. No evidence was found of a great polar ice cap.

Care of the Lawn.—An interesting little article in Garden and Forest on lawn and grass infesting insects contains some valuable information for the suburban householder. Land cultivated in one kind of crop for many years successively tends to attract all the different kinds of insects that feed upon it. In some localities where onions were grown in times past with excellent results the onion maggots now make it impossible to raise a crop. In many parts of New York State wheat culture had to be abandoned for a time because of the ravages of the Hessian fly. Farmers have long known that after land has been in pasture for a few years, or has been mowed, the grass "runs out." They accept this fact, and act upon it without much questioning as to just what this running out consists of. In many cases it is simply because the land has become so thoroughly infested with grass-feeding insects that the roots are no longer able to support a growth. Insects are not confined to farms or farm lands; they occur wherever plants are grown in cities and villages, and are troublesome in the back yard, in the kitchen garden, to the shade trees, and even to the little patch of lawn in front of the house. The more extensive the lawn and, in a general way, the better kept it is, the more attractive it is to insects. Insects of almost all orders are found in grass lands, and, as there are few grass plots in which there is not also some clover, insects infesting this plant are also more or less abundant. It is always a matter of interest to determine what is causing the injury, but, after all, the important question is, What can we do to check it? On lawns, where the object is to keep the grass as long a time as possible, one of the simplest measures is frequent cutting and rolling. This has a tendency to drive off the *lepidopterous* insects that may be among the grass, and to prevent the laying of eggs. The grass should be always kept well fed; but no barnyard manure should be used: all insects do very much better in a soil containing much vegetable matter, and are least at home where mineral fertilizers are constantly used. Lawns should be fed almost entirely with mineral fertilizers, nitrate of soda being used to furnish the necessary nitrogen, and *kainit* or muriate to furnish the potash. The fertilizer should be applied just before a rain. Where land is badly infested and there is poultry about, it is a good plan to dig up the sod and turn the chickens in for a few days. They will, if the soil is turned over two or three times, pretty thoroughly dispose of the bugs. A kerosene emulsion is fatal to the insects and does not injure the plant roots.

The Advantage of Elective Courses.—The Hon. T. W. Higginson, referring in the recollections of his life which he is now publishing in the Atlantic Monthly to the time when he was secretary of the College Natural History Society at Harvard, observes that "in looking back on the various reports written by me for its meetings, it is interesting to see that this wholly voluntary work had a freshness and vigor beyond any which

I can now trace in any of the 'themes' of which Prof. Channing thought so well. There is no greater mark of the progress of the university than the expansion of the electives to include the natural sciences. My own omnivorousness in study was so great that I did not suffer much from our restricted curriculum; but there were young men in my time who would have graduated in these later days with highest honors in some department of physics or biology, but who were then at the very foot of the class, and lost for life the advantage of early training in the studies they loved. Akin to this modern gain and equally unquestionable is the advantage now enjoyed in the way of original research. Every year young men of my acquaintance come to me for consultation about some thesis they are preparing in history or literature, and they little know the envy with which they inspire their adviser; that they should be spared from the old routine to investigate anything for themselves seems such a happiness."

Forests and River Flow.—Mr. C. C. Vermeule observes, in a report of the State Geological Survey on Forestry in New Jersey, that in estimating the relation of forests to the flow of rivers we should not consider the points of extremely high and extremely low water, but should look for the beneficial effects in the stages which prevail during the months of an ordinary dry period. "The soil and subsoil of a watershed," he says, "hold a large amount of water, which is fed out as drainage, in the form of springs and seepage, to the stream during dry periods. It is a matter of common observation that at such times rivers continue to flow when the rainfall is much less than the evaporation, and indeed for long periods when there is no rainfall at all. Anything which tends to increase the amount of water which is held in the ground, and to regulate its discharge into the streams, tends to give a larger flow, and to shorten the periods of very low water in the streams during droughts, and with this increased capacity of the ground to absorb rain come also less frequent floods. Humus in the forest forms a great sponge, and of itself holds a large amount of water, while it and the inequalities caused by tree roots, étc., tend to prevent the water flowing over the surface, and the roots of the trees provide channels by which the water percolates into the subsoil readily. In this way the forest will easily absorb a larger amount of water than open lands. A high state of cultivation also has a tendency to increase the capacity of the ground to absorb water, because of constant loosening of the surface and the facilities provided for ready drainage. In this way cultivation, like forests, tends to render floods less frequent, but the effect of the drainage of the soil is that the ground water absorbed is fed out more rapidly to the streams during the early months of a dry period than is the case in forests; consequently the ground water is sooner exhausted and the duration of the low stages of the rivers during protracted droughts is thereby lengthened. Barren watersheds offer less capacity for absorption of rainfall. There is no humus or other matter on the surface to retain the rain, and the ground becomes hard and resists free percolation."

Long-lived Seeds.—M. Casimir de Candolle said, in an account in the British Association of experiments dealing with latent life in seeds, that seeds retain their germinating faculty for very long periods of time if kept dry and protected from all external influences which would produce changes in their physiological condition. The question as to what is their physiological condition during the period of rest is an interesting one. It is possible to conceive them as absorbing oxygen or as giving off carbonic dioxide. If the latter process takes place, the carbon must be supplied from the tissues of the seed itself. In that case would the seedlings produced from these seeds be normal? The author had raised perfect seedlings from seeds known to have been kept more than a hundred years. A remarkable instance of the length of time seeds may be preserved was afforded where, on clearing away heaps of rubbish which had been undisturbed for a long time in a silver mine in Greece, the ground over which the heap had lain became in a short time covered with a mass of plants, of which the seeds from which they sprang could not have been there less than fifteen hundred years. An Irish agriculturist in the audience said that certain fields

in Ireland, which had long lain undisturbed, when plowed, produced an extraordinary crop of corn poppies. He thought that the physical texture of the soil would probably account for the long period during which the seed must have lain dormant. It seemed that in hard, closely packed soil seeds could remain in the resting state, but that they would assume their vital condition as soon as the soil was loosened. Another gentleman said that this power of seeds to germinate after a dormant period threw light on the glacial theory, since the seeds might possibly have remained buried in the quiescent state and then have germinated after the flow of ice had reached farther south.

Uses of Sawdust.—The most usual and extensive use of sawdust is probably as an absorbent on floors and in spit-boxes, but it has found many other economical applications. Compressed with pitch or with its own intrinsic resin if it be very resinous, it forms excellent kindling blocks; it may be burned as a fuel in specially prepared fireplaces. Fuel blocks are made by compressing it with various substances. An artificial hard wood is mentioned as formed in this way. At some factories it is distilled for purposes of lighting and the ammoniacal by-products. Oxalic acid is made from it by the process of Capitaine and Herlings. It forms a valuable litter for stables, and has fertilizing qualities of its own. Eggs are preserved by being carefully packed in it. With albumin, liquid paste, alum, bichromate of potash, or molasses it makes excellent briquettes; with cement, lime, or gypsum, a material for constructions; and with slaked lime, an excellent mortar. Mixed half and half with sand and clay, a material for partition walls and ceilings is formed. Sawdust is, therefore, a very useful material.

First Uses of Gunpowder.—The invention of gunpowder is shown by Mr. Oscar Guttmann, in his book on the Manufacture of Explosives, to have been most probably an evolution. The Greek fire of naphtha, mentioned by early European and Arabian writers, is believed to have been a composition containing niter, sulphur, and charcoal. Marcus Græcus, who wrote in the tenth century, gives a composition for charging rockets and crackers closely approaching that of modern blasting powder. This receipt is quoted by Albertus Magnus, and another one, not so clear, is given by Roger Bacon. None of these writers, however, speak of the use of such substances in any way like the firing of projectiles from guns; on the contrary, they all describe crackers and bombs or maroons, and say that these were discharged into towns from ballistæ or catapults or mangonels for the purpose of setting fire to them. Mr. Guttmann has found, however, in the Wardrobe Accounts of King Edward III of England, an entry between A. D. 1345 and 1349 giving credit to one Thomas of Roldeston for the king's work for his guns, for nine hundred and twelve pounds of saltpeter and eight hundred and eighty-six pounds of live sulphur. This seems to confirm the tradition that guns were used by the English at the battle of Crécy in 1346. Mr. Guttmann decides that Berthold Schwartz invented this use of gunpowder about 1313; if so, Schwartz must have been very young at the time, or else have lived to a very great age, for the date of his death is given as 1384.

French Mushrooms.—Mushroom-growing in France is a matter of ancient history, and the variety of mushrooms is infinite. The industry originated in a peculiar way. When the French began to make beds for their melons they noticed that large numbers of mushrooms would suddenly appear on the little mounds. They proved as profitable as the melons, but a crop could not be depended on. A number of investigators went to work to discover methods by which a fairly certain and regular crop could be obtained. They have partially succeeded, and the result is an industry very profitable to all concerned, and a consumption of mushrooms in France which is now something enormous. The mushroom loves a cool, damp place, and light has a decided effect upon its color, sunlight turning the surface to a reddish brown. It is for these reasons that it is usually cultivated in caves. In the department of the Seine there are over three thousand of these subterranean truck gardens, most of them de-

serted stone quarries. The people who cultivate them are said to practically live underground, and are called *champignonistes*. The beds are made as follows: A dry and clean place near the mouth of the cave is selected. The spot is covered with manure, which is allowed to lie undisturbed for several days. The manure is then thoroughly worked over, all foreign matter being removed, and then beaten and pressed down into shape. After about a week the process is repeated and the beds are watered. At the end of another week the surface will be brown and fermentation very active. At this stage the first turning must be repeated, when the mass is again allowed to rest three days. It should then be soft to the touch, but leave no moisture upon the hand. The temperature requires to be carefully watched, and the first heat of fermentation must be allowed to pass off before the *blanc* or spawn is sown. After the spawn is planted the beds are covered with a thin layer of prepared earth called *goptage*, kept well watered, and in about forty days the mushrooms will appear. A bed will with proper attention produce a continuous crop for three months. The seed, spawn, *semence*, or *blanc* (mycelium) is usually supplied by the market gardeners from old melon beds. It is sold in the shape of a brick or cake, which, if placed in a dry, airy place, preserves its vitality for several years. The annual crop of mushrooms in France is valued at about two million dollars.

Caviare in Russia.—In Russia fish plays a very important part in the economy of life. On fast days, of which there are so many, it is an indispensable article for the whole nation, and on other days many of the people, who are too poor to buy meat, depend on fish as their only animal food. Russia's numerous rivers and extensive coast line make fish a cheap and common food there. The most valuable products obtained from fish in Russia are cod-liver oil and caviare; the latter coming mainly from the sturgeon. The United States consul at St. Petersburg is given as authority for the following description of the preparation of caviare: The roe is taken out of the fish, and the egg bags in which it is inclosed are removed by rubbing the mass on a sieve; the eggs pass through the meshes, while the skin does not. When fish are in the first stage of decomposition, the egg skins get so soft that they can be readily separated from the roe, and from these the low grades of caviare are made. The caviare is next placed in brine. The difference between the so-called fresh caviare and the ordinary material put up for keeping or export consists in the longer or shorter time it is allowed to remain in the brine, and also on the strength of the latter. Immediately after the eggs have been rubbed through the sieve, they are put through the brine, and as soon as they are deprived of the superfluous salt, are placed in tin jars or cans and small wooden kegs, and the so-called fresh caviare, which is high priced, is ready for market. The cheaper kind is cured in the brine and then put into linen bags and pressed. This is called pressed caviare. During ten months of 1895 Russia exported 4,658,448 pounds of pressed and 613,904 pounds of fresh caviare.

Venomous Fishes.—In many seas, especially those of the tropics, are found fish provided with a poison apparatus, which consists usually of a spine or spines more or less erectile in character, and connected with a poison gland. Prof. James D. Brunton gives an interesting account of two of these fishes, the *Trachinis draco* and *Scorpæna scropha*. They are only poisonous as a serpent is poisonous —i. e., by wounding; their flesh is good and wholesome. Although the fish differ widely in appearance, yet the poison produces the same effect. The *Trachinis draco* is a handsome fish, not unlike a trout in general appearance. Upon each of its gill covers is situated the spine, connected with its poison gland through a duct formed by the combination of a groove in the spine and a very thin membrane, which covers the latter almost to its point. When the spine enters a resisting body, the membrane is pushed back, allowing the poisonous secretion free access to the wound. The gland is small, with nucleated colorless cells secreting a transparent fluid. The *Scorpæna*, on the other hand, is an unattractive-looking fish, squat of body and having a large, misshapen head. It may attain a large size, and is called by the French fishermen "*le diable*." The special organ in this fish is connected

with the first three rays of the dorsal fin, the duct being formed as in *Trachinis*. There is also a spine on each gill cover connected with a poison gland. The effect of a wound from either of these fish is quite a serious matter. At the moment of puncture only the sharp prick is felt. In a few minutes, however, the part commences to burn and itch, and then becomes acutely painful. These pains increase in violence and extent. Then a feeling of suffocation is felt, and pain over the heart. From this time commence those cries of anguish which can always be recognized as caused by the acutest torture and fear. The cries are continuous, and beads of sweat stand on the brow. Flashes of light pass before the eyes, and the pulse is found to beat intermittently. Finally, delirium and convulsions supervene, which may pass on to collapse and death, or may, after lasting for many hours, gradually subside, leaving a *malaise* which is very difficult to get rid of. The point of puncture soon shows the results of intense irritation, and may eventually become gangrenous and necessitate amputation. The treatment is practically the same as that for a snake bite. The poison approaches that of the serpent in character, being alkaloidal, very quickly decomposed, and intensely rapid in action. It is secreted in larger quantities at the spawning season, and is most active in the male fish. On coasts where these fish abound it frequently happens that bathers are poisoned by stepping on one of them, the *Trachinii* being especially fond of concealing themselves just under the sand in shallow water. It would be of interest to know whether Dr. Calmette's snake-bite antitoxin is also efficient against the venom of these fishes.

Baku.—A very interesting account of Baku, the great petroleum center in Russia on the Caspian Sea, is given by W. F. Hume. Its growth, it seems, has been almost Western in rapidity. What was an insignificant town of fourteen hundred inhabitants thirty years ago, is now a flourishing city of over one hundred thousand souls whose population is still rapidly increasing. Two causes have combined to bring about this rapid growth: First, its magnificent harbor, and, secondly and chiefly, its proximity to the main area of naphtha supply, which already rivals that of America in productiveness. Several attempts were made to start refineries in this district, the first by the brothers Doubinnin in 1823, but until 1859, when M. Kokareff founded the Baku Petroleum Company, none of them were successful. In 1865 the first refinery was established in Baku itself, and so rapidly did the industry develop, that in 1873 the town was in danger of becoming entirely absorbed by the distilleries that rose on every hand, while the black, dense, and acrid smoke from the naphtha-fed furnaces poisoned the atmosphere. The nuisance became such a serious one that the whole industry was moved outside the town (by an edict of the Government, which is Russian). How intolerable it had become, may be inferred from the fact that the sole firing material for the furnaces was the refuse oil, and no smoke-consuming appliances were employed; not only the buildings but the whole surface of the ground became coated with a thick layer of soot, while the roads were almost impassable, owing to pools and ponds of oil. The city received the name, *Tchornoia Gorod* (black town), which still clings to it. Through the use of a smoke-consuming device the present factory district is quite free from soot, and is hence called the white town. Baku is a commercial center, but most undesirable for residential purposes. It is subject to heavy dust storms, rainlessness, intense heat, and there is an almost entire absence of vegetation and fresh water. The only garden is the so-called Alexander II, maintained at great expense, the shrubs and trees being planted in imported soil. The spot of chief interest about the town is the plateau of Balachani-Sabountchi, situated about eight miles to the northeast of Baku. Here are located the great petroleum wells. Viewed from a distance the tall, closely set, truncated towers erected over the wells look almost like a pine forest. These pyramids consist of a wooden boarded framework, and are easily removable when the bore becomes exhausted. The Baku district is so saturated with naphtha oils that there is an ever-present danger of serious fires through the ignition of the hydrocarbon gases, which escape not only from the bores but through every fissure and cleft in the soil, and, although every possible precaution is taken, many disastrous fires have occurred.

A feature of considerable interest is the ancient temple of Zoroaster, which for twenty-five hundred years was the sacred resort for pilgrimage of the Guebers or fire-worshipers of Asia. Although, owing to its importance as a commercial center, Baku at present almost monopolizes the petroleum industry in southern Russia, it is but one of many important oil fields in this district.

Life in the Coldest Country.—The coldest region of the globe, that of Werkojank in Siberia, where the lowest temperature of —90° F. has been observed, and the mean of January is —48° F., is inhabited by about ten thousand five hundred persons of the Jakut and Lamut races. In a large part of the region, according to the representations of Mr. Sergius Kovalik in the Bulletin of the Geographical Society of Irkutsk, the air is so dry and winds are so rare that the intensity of the cold is not fully realized. Farther east there are sometimes terrible storms. In the summer time the temperature sometimes rises to 86° F. in the shade, while it freezes at night. The latter part of this season is often marked by copious rains and extensive inundations. Vegetation is scanty. There are no trees, only meadows. The people hunt fur-bearing animals, fish, and raise cattle and reindeers. It requires about eight cows to support a family, four being milked in the summer and two in the winter. The cattle are fed hay in the winter, and are allowed to go out occasionally when it is not too cold, their teats being carefully covered up with felt. Milk is the principal food, occasionally supplemented with hares, which are quite abundant. The houses are of wood, covered with clay, and consist of one room, in which the people and their animals live together. The wealthier classes are better provided with lodging and food. The people are very hospitable, but excessively punctilious concerning points of honor, such as the place at table.

MINOR PARAGRAPHS.

THE great work described by M. P. Demoutzey in reforestation and the stemming of mountain torrents in France has been fittingly eulogized by M. Dehérain. Not more than a quarter of the work contemplated has been accomplished; but that which has been done proves what may be done, and that the solution of the difficult problem has substantially been reached. The needed work is not long or very expensive; it is only to assist Nature by easy and simple devices, and keep at it. When this is done, thirty or forty years will be long enough to produce great changes in the conditions and appearance of a devastated and torrent-rent region. M. Demoutzey's book is illustrated with plates and photographic views showing the character of the work accomplished.

ORIGINALLY the area of natural gas in Indiana, according to the last report of W. S. Blatchley, State Geologist, embraced part or all of seventeen counties lying northeast of the center of the State, and comprised about five thousand square miles. On account of the encroachment of salt water and petroleum this area has become gradually reduced, until to-day the main gas field includes an approximate area of twenty-five hundred square miles. This, however, it is claimed, is larger than has ever been possessed by any other State in the Union. The average initial or rock pressure of the entire field in 1889 was three hundred and twenty-five pounds to the square inch. To-day, according to careful measurements, it is two hundred and thirty pounds to the square inch over the main field. Hence it is not doubted that the supply is diminishing, and that, as there can be no increase of it, the pressure will decrease more rapidly in the future than it has done in the past. The diminution in pressure is most noticeable in cities like Indianapolis and Richmond, which receive their supply through pipe lines, and less so in the cities that lie wholly within the field.

THE library of the distinguished chemist August von Kekulé, of the University of Bonn, lately deceased, is in the hands of Gustav Fock, Magazingasse 4, Leipzig, for sale. Seldom has a collection of such value been put on the market. It was made with rare zeal and most intelligent judgment exercised through many years, and is so complete that hardly any work of scientific

character and standing or scientific journal is missing from it. It contains about eighteen thousand volumes, dissertations, pamphlets, etc., most of which are bound. Among the treasures of the library are complete sets from the beginning up to 1895 or 1896 of twenty-five of the most important scientific (particularly chemical) periodicals—German, French, Italian, English, and American—and series of from fifteen to twenty-five years of six others; and a rich collection of alchemistic books published in former centuries. It seems to us very important that this collection should be kept in its integrity; indeed, it might be regarded as a scientific misfortune if it should be scattered; and it is to be hoped that some learned institution or library, or some benefactor of such, may find the way clear to buy it as a whole.

THE researches of M. King concerning the retention of moisture in the soil, while they confirm the view that good cultivation offers an impediment to evaporation, show that bad harrowing and incomplete stirring of the soil have a different effect. A harrowing which simply scratches the ground without covering it with loose earth increases evaporation instead of diminishing it. So a dressing of the soil which extends to less than three centimetres in depth offers but a slight impediment to the escape of water. But a thin coating of dry earth (two centimetres) suffices to reduce the evaporation considerably, and a stirring of the soil from five to seven centimetres in depth will cause the moisture in arable land to be retained. The influence of manures was also studied. They isolate the surface, expose it to complete desiccation, and cause suffering to the crops, particularly in dry weather. The manure in another season becomes mixed with the soil, and the inverse effect is observed. The superficial layers gain moisture.

IT appears from the studies of H. L. Russell and John Weinziel of the bacterial flora of American Cheddar cheese at the various phases of the ripening process, reported upon at the American Association, that for the first ten days the number of microbes diminishes from that contained in the milk. Soon an enormous development of organisms of the lactic-acid group begins, while the digesting and gas-producing bacteria gradually decrease. A period of decline succeeds this stage, and continues throughout the life of the cheese until, in the course of a year or two, it is almost sterile. The physical changes that mark the curing of the cheese begin to appear at the same time with the marked development of lactic-acid bacteria. The authors hold that these facts can not be reconciled with the theory that the digesting bacteria are the active agents in the curing.

ONE of the curious animal stories published in the London Spectator is of a dog belonging to an Oxford University man, which, being excluded from the college at night according to the rules, is kept at a house some distance off. Every morning it comes of its own accord to the owner's rooms, and is accompanied in its morning walk by a Cochin-China hen and a kitten belonging to the man with whom the dog is left during the night. The hen and kitten, not being permitted to enter, always leave the dog at the college (Balliol) gates. Another story in the same number of the Spectator relates to a canary bird whose seed trough was always found empty, though kept well supplied. One morning, observing that the bird appeared much excited and was singing lustily, its master looked and saw a mouse slowly climb down the cord, get through the bars of the cage, and, reaching the seed trough, eat the food with great relish, while the bird continued to sing. Finally, a cat caught the mouse, and the canary was never known to sing again.

AN odd controversy has been going on between the Roman Catholic Journal, *Volkszeitung*, of Cologne, and the Abbé Künzle, of Feldberg, in Tyrol, concerning the authenticity of an alleged signature of the devil. The *Volkszeitung* denies the authenticity, and insists that it is not possible to procure an authentic signature of his Satanic Majesty. The abbé declares, on his side, that the devil Vitru appeared in October, 1883, in the lodge room of a Masonic lodge, where were several eminent men, including M. Crispi, and announced that a young woman named Sophia Sapho, who was present, would on the following September give birth to a daughter, who would be the grandmother of

the Antichrist. He even condescended to sign a minute, which was drawn upon the spot, attaching to it the title *Sanctus Demon Primarius Præses*—which may mean "Holy Devil, First President"—with his signature, consisting of various symbolical signs, among which were a cock, a fork, etc. The *Volkszeitung* declares that it is superstition to believe in the authenticity of the signature, although it credits the possibility of compacts between the devil and the wicked. Père Künzle believes that it is consistent with sound doctrine to hold that the signature is that of the Prince of Evil. This is the point of controversy; and the scientific may look on, though not troubled about the matter.

NOTES.

M. Émile Rivière has discovered and explored for a length of one hundred and twenty-seven metres a prehistoric grotto in the department of Dordogne, France, the walls of which are covered with designs cut in the rock. As some of the figures pass under stalagmites, a great age is predicated for them.

M. Olszewski, having failed to liquefy helium, calculates that its boiling point is below —264° C., or at least 20° below that of hydrogen. Were the temperature of ebullition calculated as a function of the density, it would be much higher, the density of helium being double that of hydrogen. Both helium and argon have boiling points much lower than was supposed—a fact which may be accounted for by the monatomic structure of the two substances.

A number of neolithic axes were described in the American Association by Prof. E. W. Claypole, which were found at New London, Huron County, Ohio, by an intelligent workman while digging a well in the blue clay at twenty feet below the surface. The features of the formation were those characteristic of the glacial deposits of northern Ohio. Heretofore, numerous flying reports of the discovery of implements in the glacial till have been made, but this, Prof. Wright says, is the first instance where the evidence has seemed in itself altogether convincing and satisfactory.

Bearing in mind that an estimated average length of pupilage is frequently made an important consideration in arranging some of the points of school management, Prof. C. M. Woodward undertook to deduce, from the comparison of the school statistics of several cities, the average age at which pupils withdraw from the public schools to engage in the active duties of life, or to enter private schools. He could get full statistics only from St. Louis, Chicago, and Boston. In these cities the average age of withdrawal is, severally, 13·3, 14·5, and 15·9 years.

M. Loewy, a fully trained astronomer who has made his reputation along many lines of research, and who has for many years belonged to the staff of that institution, has been selected by the French Government to succeed M. Tisserand as Director of the French Observatory.

Recent researches by Prof. J. A. Hennig indicate that pure metals have their electrical conductivity immensely increased by intense cold, while alloys experience in the same circumstances a comparatively small increase, not more than ten per cent. Prof. Hennig lays great stress on the value of these facts, as a means of testing the purity of a metal, almost rivaling the spectroscope in delicacy.

It is said that the German Government has recently sent Prof. Koch and Dr. Kohlenstock, both bacteriological experts, to the Cape to inquire into the plague of rinderpest, and to report what measures are best to prevent its spreading to the German Southwest African colonies.

At a meeting held at St George's Hospital (London) early in December, it was resolved "That the present year, being the centenary of the first successful vaccination, is an appropriate time to inaugurate a work of national utility in honor of Edward Jenner." A second resolution to the following effect was passed: "That a subscription be set on foot with the view of founding some institution of a nature to be hereafter determined in connection with the British Institute of Preventive Medicine, to be distinguished by Jenner's name."

The forest department in India is now paying its way handsomely and more, the profits having been going up steadily since 1875. While for the five years ending with that they stood at eleven lakhs, the profits for the five years ending in 1895 were fifty-three lakhs, or just short of five times as much.

Miss M. Peacock has published a paper in the magazine Folk Lore on executed criminals and folk medicine, in which are collected instances of belief in the medical effects of the touch of the body of an executed criminal.

An account of a number of remarkable cases of psychical or hypnotic phenomena which have fallen under his own observation, or have been investigated by the Society for Psychical Research, has been prepared by Dr. R. Osgood Mason, of this city, and is to be published by Henry Holt & Co., under the title of Telepathy and Subliminal Research. It will illustrate a theory held by the author and some other investigators of a principle

pervading all the phenomena in question of a second self, to which the name subliminal (under the threshold) has been given, that acts and perceives in manners entirely unknown to our ordinary everyday consciousness.

THE French colony of New Caledonia is troubled by the depredations of deer, which multiply with marvelous rapidity and invade the plantations, where they do great mischief, even climbing up into the granaries. A curious feature of the trouble is that the deer are not native, but are the offspring of a present made to the colony by the Queen of England. The *Revue Scientifique* draws from this fact a lesson that it is well to be cautious concerning the gifts of animals we may bestow upon other countries, and not make them without advice from experts concerning the conditions and contingencies. Rabbits in Australia, the mongoose in Jamaica, and the New Caledonian deer afford instances in which such gifts, made with the best intentions, have resulted disastrously. It is said that the farmers of the State of Maine have also suffered from the incursions of deer since restrictions were placed upon the hunting of them.

WOMEN are gradually working their way into the German universities, where a few have been admitted, not as of right, but as of favor. Five ladies have up to this time taken the doctor's degree at Heidelberg. One of them, an American, made so brilliant a success that she was at once offered an appointment at the German zoölogical station near Naples.

THE curious fact is noted by Mr. C. C. Vermeule, in his forest studies of New Jersey, that less disposition to destroy and waste the forests is shown by the native population than by the immigrants from countries where the control and management of the forests are, on the whole, superior to our modern methods.

THE gypsies—those of Hungary, at least—are not all wanderers. Of 274,940 representatives of that race enumerated in 1893, 243,432 were described as sedentary, 20,406 as semi-sedentary, and only 8,938 as nomads, while 2,164 were soldiers or prisoners. All of them profess one of the various forms of Christianity of the people among whom they dwell, and only 82,405 are still able to talk gypsy dialects. Seventeen thousand of them are musicians.

PROF. EMIL DU BOIS-REYMOND, of the University of Berlin, one of the most famous and many-sided German men of science, died, December 26th, aged seventy-eight, having been professor at Berlin since 1855. He had been suffering for several months from general debility, but his death, when it came, was sudden, though not unexpected. He was one of the earliest and most vigorous champions of the doctrine that biological phenomena are governed by physical and chemical laws, and ranked alongside of Tyndall and Huxley as a lecturer and popularizer of the natural sciences. Several of his ablest addresses have been published in the Monthly, including the Seven World Problems and The Limits of Our Knowledge of Nature—perhaps the two most famous of all. A sketch of his life and work to that time was published, with a portrait, in the Popular Science Monthly (vol. xiii) for July, 1878.

WE have learned of the death of the Hon. Horatio Hale, of Clinton, Ontario, one of our most distinguished anthropologists, particularly in the study of aboriginal languages, but have received no details of the event. He was the author of several valuable articles in the Monthly.

DR. HENRY TREMEN, formerly Director of the Botanic Garden at Peradenyia, Ceylon, who died October 10th, in his fifty-third year, was author of the Flora of the County of Middlesex, England, and, in conjunction with Prof. Bentley, of a standard work on Medical Botany; and had prepared a complete Flora of Ceylon, of which three parts have appeared.

AUGUST TRÉCUL, who recently died in his seventy-sixth year, a distinguished plant anatomist and author of important technical studies in his specialty, spent three years in Texas, collecting material for the Paris Museum, and studying the textile plants used by the Indians.

CAPTAIN JOHN GREGORY BOURKE, of the United States Cavalry, who died June 8th, besides being a gallant soldier, was an ethnologist of much repute. He had done much work in connection with the Bureau of Ethnology, and spent five years from 1886 in Washington compiling the ethnographic notes he had collected during his service in the West, and pursuing collateral studies. His most famous work was on the Snake Dance of the Moquis of Arizona, which attracted great attention all over the world and brought into prominence a branch of anthropology which had been relatively little studied. He was also author of works on the Medicine-men of the Apaches, and Scatalogic Rites of All Nations.

HUGO GYLDEN, Astronomer of the Royal Swedish Academy of Sciences and Director of the Observatory of Stockholm, who died November 9th, ranked with M. Tisserand as one of the most illustrious mathematical astronomers on the European continent. He was the son of Prof. Gylden, of the University of Helsingfors, where he was born in 1841. He was best known by the work which he had carried on since the death of Leverrier on the general theory of perturbations, and by his great treatise on the absolute orbits of the eight principal planets.